Operations and Maintenance Manual for the Water Reclamation Plant (WRP)

Prepared for
Cowlitz Indian Tribe

May 2017

Prepared by
Parametrix

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The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.

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KEY TERMS

A	ampere
APHA	American Public Health Association
ATS	automatic transfer switch
AWWA	American Water Works Association
BOD	biochemical oxygen demand
BOD_5	5-Day Biochemical Oxygen Demand
C	Celsius
CAS	Chemical Abstracts Service
CFR	Code of Federal Regulations
CIP	clean-in-place
CLS	chlorine solution
CP	Control Panel
CPU	Clark Public Utilities
DI	ductile iron
DO	dissolved oxygen
Ecology	Washington State Department of Ecology
EPA	Environmental Protection Agency
EQ	equalization
EUSERC	Electric Utility Service Equipment Requirements Committee
F	Fahrenheit
FF	feed forward
FM	force main
$gal/foot^2$	gallons per square foot
gpm	gallons per minute
HMI	Human Machine Interface
HOA	HAND-OFF-AUTO
hp	horsepower
HVAC	Heating, Ventilation, and Air Conditioning
Hz	Hertz
I/O	input/output
JOR	JOG-OFF-REMOTE
Kubota	Kubota Membrane USA Corporation

KEY TERMS (CONTINUED)

kV	kiloVolt
kW	kilowatt
LAH	High Level Alarm
LAL	Low Level Alarm
LOTO	lock-out/tag-out
mA	milliampere
MBR	membrane bioreactor
MCCs	Motor Control Centers
MDL	method detection limit
mg/L	milligrams per liter
mgd	million gallons per day
$MgOH_2$	Magnesium hydroxide
mJ/cm^3	millijoule per cubic centimeter
ml	milliliter
ML	mixed liquor
MLR	Mixed Liquor Return
MLSS	mixed liquor suspended solids
MM	Maximum Month
mm	millimeter
mma	maximum monthly average
MOP	Manual of Practice
MPN	most probable number
N.C.	Normally Closed
N.O.	Normally Open
NAWA	Native America Water Association
NFPA	National Fire Protection Association
NH_3-N	Ammonia-Nitrogen
NIOSH	National Institute of Occupational Safety and Health
nm	nanometers
NTU	Nephelometric Turbidity Units
O&M	operation and maintenance
OIU	Operator Interface Unit

KEY TERMS (CONTINUED)

ORP	Oxidation-Reduction Potential
OSHA	Occupational Safety and Health Administration
P&IDs	process and instrumentation diagrams
PCs	personal computers
PFD	process flow diagram
PID	proportional-integral-derivative
PLCs	Programmable Logic Controllers
PQL	practical quantitation limit
PRV	pressure relief valve
psi	pounds per square inch
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
Resort	ilani Casino Resort
SCADA	Supervisory Control and Data Acquisition
scfm	cubic feet per minute at standard conditions
SDS	Safety Data Sheets
SDS	Screened Degritted Sewage
SDWA	Safe Drinking Water Act
SMUs	submerged membrane units
TDH	total dynamic head
TKN	Total Kjeldahl Nitrogen
TMP	transmembrane pressure
TN	total nitrogen
Tribe	Cowlitz Indian Tribe
TSS	Total Suspended Solids
UIC	Underground Injection Control
USDW	underground sources of drinking water
V	Volt
Vac	Volts ac
Vdc	Volts direct current
VFDs	variable frequency drives
WAS	waste activated sludge

KEY TERMS (CONTINUED)

WEF	Water Environment Federation
WRP	Water Reclamation Plant
WWTP	wastewater treatment plant

1. INTRODUCTION TO THE OPERATIONS AND MAINTENANCE MANUAL

1.1 Purpose of Manual

This manual has been designed as a general guide for the operation and maintenance (O&M) of the Cowlitz Indian Tribe's (the Tribe's) Water Reclamation Plant (WRP). The manual provides the overall WRP operating strategy and functional descriptions, including normal and emergency operation, start-up/shutdown procedures, and maintenance of the systems and components of the WRP. The information in the manual is intended to help new operators learn the system and provide a resource for all operators when dealing with equipment or process problems.

This manual is a compilation of many sources of information and is intended to be used in conjunction with the significantly more detailed manufacturer O&M manuals.

1.2 Organization of Manual

The organization of this manual is as follows:

- Chapter 1 provides an overview of and notes on the manual itself; general information about the collection system, WRP location, and owner and operator responsibilities; general guidelines for overall facility maintenance; and related O&M documents.
- Chapter 2 provides the pertinent regulatory requirements for operating the reclaimed water facility. The requirements are included as an Appendix A to this manual and should be replaced if and when regulatory requirements or values change.
- Chapter 3 provides an overview of the treatment facility by unit process. Chapter 3 also provides flow schematics, design data, and a hydraulic profile for the facilities.
- Chapters 4 through 16: These chapters provide more detailed descriptions of the operations and daily maintenance of each process unit or system. These chapters describe both collection system units and the treatment processes, divided into the following processes: Collection System, Headworks/Screening, Influent Pumping, Flow Equalization, Biological Treatment Trains, Feed Forward Pumping, Solids Storage, Disinfection, Reclaimed Water System and Well Injection Pumps, Vadose Zone Injection Wells, Auxiliary Systems, and Instrumentation and Controls.
- Chapter 17 provides an overview of the Site Utilities.
- Chapters 18 through 20 include information on Sampling Laboratory Protocol, Safety Guidelines, and Emergency Procedures.

In addition, appendices of this manual contain the following:

- Appendix A: EPA Underground Injection Control Requirements.
- Appendix B: Process and Instrumentation Diagrams.
- Appendix C: Alarm List.
- Appendix D: SCADA Screens.
- Appendix E: Vadose Zone Well Reports.
- Appendix F: Lockout/Tagout Policy.

Finally, the manufacturer's O&M manuals and Record Drawings are considered part of this O&M manual by reference.

In this manual, an OPERATOR'S NOTE indicates an important feature, a handy tip, or other information that is useful to the operating staff.

In this manual, a MAINTENANCE NOTE indicates an important reminder, handy tip, or other information that is useful to the proper maintenance of the WRP.

A SAFETY NOTE! indicates a precautionary warning regarding the operation or maintenance of the facility. These notes do not replace or supersede the manufacturer's warnings shown in the manufacturer's O&M information. These notes are precautions to warn of potentially harmful conditions that may be due to the location, layout, or interaction of one or more pieces of equipment. The notes are meant to provide the operator with notice of potential danger in areas that may not be readily apparent.

1.3 Updating the Manual

The WRP staff should review this O&M manual at least annually. It is very important that all modifications, refinements, or changes to plant operation be noted in this manual for record-keeping purposes. Operators are encouraged to update spreadsheets, forms, checklists, tips, and procedures, and add notes related to operator experience as necessary. New operators will have the benefit of understanding exactly what modifications have been made and why.

1.4 General Information

The Cowlitz Indian Tribe collaborated with Salishan-Mohegan LLC to create the ilani Casino Resort (Resort) on Cowlitz Tribe trust land north of Ridgefield, Washington. To provide treatment for the wastewater generated by the current and future resort development, and to provide enhanced environmental protection in the service area, the Cowlitz Tribe constructed a WRP. Wastewater from the Resort is directed to the WRP, where it is treated by a membrane bioreactor (MBR), which produces Class A reclaimed water. Vadose Zone Injection Wells function as a discharge point for aquifer recharge unless reclaimed water is used by the WRP or the Resort.

The MBR submerged membrane units (SMUs) and much of the ancillary equipment associated with the MBR process were supplied by Kubota Membrane USA Corporation (Kubota). Notes in the Record Drawings delineate what equipment is Kubota-supplied.

OPERATOR'S NOTE: The warranty and/or warrantied operating conditions for Kubota-supplied equipment may differ from that of other equipment at the WRP. Operators should pay particular attention to which pumps, blowers, etc. are provided by Kubota in case warranty issues arise.

Table 1-1 summarizes equipment and instruments supplied by Kubota.

Table 1-1. Summary of Kubota-Supplied Equipment

Drawing Tag	Equip Name	Plan Sheet	Physical Location
AE-21205	Aeration Tank 1 Dissolved Oxygen (DO), Temporary Transmitter	P5	Aeration Tank No. 1
AE-22205	Aeration Tank 2 DO, Temporary Transmitter	P6	Aeration Tank No. 2
SMU-21301	MBR 1 Membrane Module 1	P5	MBR Tank No. 1
SMU-21302	MBR 1 Membrane Module 2	P5	MBR Tank No. 1
SMU-21303	MBR 1 Membrane Module 3	P5	MBR Tank No. 1
SMU-21304	MBR 1 Submerged Membrane Module 4	P5	MBR Tank No. 1
LSH-21303	MBR 1 High Level Switch	P5	MBR Tank No. 1
LSL-21302	MBR 1 Level transducer MBR 1 Low Level Switch	P5	MBR Tank No. 1
SMU-22301	MBR 2 Submerged Membrane Unit 1	P6	MBR Tank No. 2
SMU-22302	MBR 2 Submerged Membrane Unit 2	P6	MBR Tank No. 2
SMU-22303	MBR 2 Submerged Membrane Unit 3	P6	MBR Tank No. 2
SMU-22304	MBR 2 Submerged Membrane Unit 4	P6	MBR Tank No. 2
LSH-22303	MBR 2 High Level Switch	P6	MBR Tank No. 2
LSL-22302	MBR 2 Level Transmitter MBR 2 Low Level Switch	P6	MBR Tank No. 2
P-25001	Permeate Pump 1	P9	Mechanical Room
AE-21105	MBR 1 Turbidity Transmitter	P9	Mechanical Room
PT-21305	MBR 1 TMP Pressure Transmitter	P9	Mechanical Room
FE-25103	MBR 1 Permeate Flow Element	P9	Mechanical Room
P-252003	Permeate Pump 3	P9	Mechanical Room
AE-25205	MBR 2 Turbidity Transmitter	P9	Mechanical Room
PT-22305	MBR 2 TMP Pressure Transmitter	P9	Mechanical Room
FE—25203	MBR 2 Permeate Flow Meter Transmitter	P9	Mechanical Room
P-25002	Permeate Pump 2	P9	Mechanical Room
BLR-27001	Aeration Blower 1	P13	Mechanical Room
BLR-27002	Aeration Blower 2	P13	Mechanical Room
BLR-27100	Standby Blower	P13	Mechanical Room
FE-27011	MBR 1 Aeration Air Flow Meter Element	P13	Mechanical Room
FE-27012	MBR 2 Aeration Air Flow Meter Element	P13	Mechanical Room
XV-29001	MBR Cleaning Hypochlorite Dilution Water Control Valve	P15	Chemical Room
FE-29002	MBR Cleaning Hypochlorite Flow Meter	P15	Chemical Room
P-25003	Permeate Pump 3	P9	Mechanical Room
Missing:	Aeration blowers, diffusers, mixers, Anox mix, control panel, etc.		

1.4.1 Location and Sewer Service Area

The WRP facility is located on Northwest 31st Avenue, southeast of the Resort on Cowlitz Tribe trust land. The overall site is located west of Interstate 5 at Exit 16 north of Ridgefield, Washington. The WRP serves the Resort area and the remainder of the 152 acres of adjoining Cowlitz Tribe trust land. The design maximum 30-day-average flow for the two-train system (initial construction) is 195,000 gallons per day. The maximum 30-day-average flow rating for the four-train system will be 390,000 gallons per day.

1.4.2 Collection System

Flow from the Resort is collected by an 8-inch gravity sewer system, which conveys flow to a pump station located on the west side of the casino parking area. All of the all flow to the WRP is pumped by the pump station through an 8-inch sanitary sewer force main. Since the collection system is new, infiltration and inflow are not expected to be excessive. The collection system will be expanded to adjacent areas of the Resort as development occurs.

1.4.3 Plant and Operator Classification

It is recommended that every operator in responsible charge be certified at a level equal to or higher than the classification of the facility being operated. In addition, the operator in charge of each shift be certified at a level no lower than one class below the WRP classification.

It is recommended that an operator certified for at least a Class III plant by the state of Washington or the Native America Water Association (NAWA) shall be in responsible charge of the day-to-day operation of the wastewater treatment plant, and an operator certified for at least a Class II plant shall be in charge during all regularly scheduled shifts.

For information on WWTP/WRP operator certification requirements and/or application forms, call or write:

Water and Wastewater Certification Board
c/o Washington State Department of Ecology
Water Quality Program
P.O. Box 47696
Olympia, Washington 98504-7696
(360) 407-6426 or 1-800-633-6193
http://www.ecy.wa.gov/programs/wq/wastewater/op_cert/

The Washington Environmental Training Center office has updated information on training programs for wastewater treatment plant (WWTP) personnel, and publishes a newsletter every 3 months titled "Water/Wastewater Training News." The newsletter contains current information on statewide training opportunities, certification examinations, and other items of interest to water and WWTP operators. To receive the "Water/Wastewater Training News" or have general training questions answered, contact:

Washington Environmental Training Center
12401 SE 320th Street, Mail Stop WW
Auburn, Washington 98002
(253) 288-3369, or 1-800-562-0858
http://www.wetrc.org/

The NAWA provides tribal water and wastewater training and technical assistance programs, tribal water and wastewater operator certification programs, on-site training, utility ordinance development, operation and maintenance assessments, Native American Water Association operator and manager apprentice training programs, and other training and technical assistance opportunities.

Native American Water Association
1662 Highway 395, Suite 212
Minden, NV 89423
(775) 782-6636
http://www.nawainc.org

1.4.4 Plant Staffing

The Cowlitz Indian Tribe operates the WRP. This facility must be adequately staffed to perform operation and maintenance tasks related to administration, treatment, solids handling, and laboratory analysis. Although the Environmental Protection Agency (EPA) does not stipulate how many operators must be on-site, a laboratory technician, plus treatment system and collection system/maintenance personnel, is recommended.

1.4.5 Owner Responsibilities

The Cowlitz Indian Tribe is responsible for the collection and treatment of wastewater generated within the sewer system service area and disposal of the reclaimed water produced by the WRP. It is the responsibility of the Tribe to provide adequate financing for operation and maintenance of the system, and replacement of system components as needed. The Tribe is responsible for managing both the WRP and achieving the minimum levels of treatment required by the EPA regulations.

Management responsibilities include:

1. Finance efficient plant operation and maintenance, including providing appropriate staff.
2. Maintain adequate operation and management records.
3. Provide good working conditions, safety equipment, and proper tools for sewer utility personnel.
4. Establish and maintain an operator training program.
5. Prepare budgets.
6. Maintain good relations with treatment plant neighbors and the general public.

1.4.6 Operator Responsibilities

System operators are responsible for operating the treatment plant at peak efficiency at all times. They must equip themselves with proper training and experience so that they can cope with all emergencies. The operators must understand the need for preventive maintenance to prolong the life of mechanical equipment and structures. The operators are responsible for conducting laboratory tests needed to monitor the efficiency and effectiveness of the WRP and meet minimum monitoring requirements of EPA.

Operator responsibilities also include the following:

1. Comply with all appropriate regulations regarding the treatment plant.
2. Ensure the safe disposal of reclaimed water and solids.
3. Know proper operational procedures.
4. Operate the treatment system efficiently.
5. Take various types of samples with consistency to accurately monitor plant performance.
6. Keep continuously informed of the best operating and maintenance practices.
7. Maintain accurate and neat operation and maintenance records.
8. Use sound judgment in the expenditure of operating funds.
9. Keep the Tribe advised of potential problems in operation and maintenance of the system.
10. Be aware of safety hazards connected with wastewater treatment and be prepared for emergencies.
11. Present a clean, attractive appearance of all visible portions of the system.
12. Report any changes in this manual and equipment operation and maintenance manuals to other operators. Mark this manual with periodic updates or whenever any change is made that deviates from the current contents.
13. Prepare reports on operation of the WRP for submittal to the appropriate regulatory authority.

1.4.7 Regulatory and Reporting Requirements

Appendix A contains information on the EPA's Underground Injection Control requirements. Operators should be thoroughly familiar with these requirements.

1.4.8 Plant Control System

The WRP Supervisory Control and Data Acquisition (SCADA) system consists of server based computers, personal computers (PCs), and Programmable Logic Controllers (PLCs) which receive and process information (such as motor status, flow rate, tank level, etc.) from the various equipment components using a ladder logic program. The PLCs then send signals back to the equipment, which act as instructions for how the equipment is to operate. The SCADA software at the server and PCs provides operators with a "window" into the WRP process control system from which to observe and control plant processes. Human Machine Interface (HMI) screens allow operators to monitor and interact with the system both at the laboratory PC and at the various control panels.

1.5 Overall Plant Maintenance

The objectives of a plant maintenance program are to:

- Ensure reliability of operation.
- Protect the community's investment in the facility.
- Ensure maximum safety for all.

Maintenance is performed on the buildings, grounds, and all operating equipment associated with the treatment plant. Maintenance includes all the activities, work, and precautions taken to achieve the above objectives. The purpose of this section is to outline the basic elements of the maintenance program.

SAFETY NOTE! Table 1-2 provides information on classified hazardous locations within the WRP. Exercise particular caution when maintaining equipment in the following areas noted.

Table 1-2. Classified Hazardous Areas in Plant[a]

Area	Class	Division	Extents
Influent Pump Station, Grinder Pump Station, and Influent Manhole	1	1	Inside
Equalization Tank (Future)	1	1	Inside, only when sewage present
Influent Pump Station, Grinder Pump Station, and Influent Manhole Hatches	1	2	Around Hatches: 1.5 feet high, 3 feet horizontal from edges of hatch opening
Headworks (Current)	1	2	Current: Interior of channels from minimum water level to top of wall extending 18 inches above top of channels and 18 inches beyond the exterior wall and also an envelope 18 inches above grade extending 10 feet horizontally from walls
Headworks (Future Enclosed Building)	1	1	Future Building: Inside Screening/Grit Room
Headworks Odor Control System (Future)	1	2	Within 3 feet of leakage sources such as fans, dampers, flexible connections, flanges, pressurized unwelded ductwork, and odor-control vessels
Anoxic, Aeration, MBR, and Solids Tanks	1	2	Interior of tank from minimum water level to top of wall extending 18 inches above top of tank and 18 inches beyond the exterior wall and also an envelope 18 inches above grade extending 10 feet horizontally from walls
Mechanical Room	Unclassified		
Utilidor	Unclassified		Unless there is a break in the screened sewage pipe

[a] Refer to National Fire Protection Association (NFPA) 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities for further information.

1.5.1 Equipment Record System

The essentials for a useful record system include:

- Equipment categorization, list of attention points, oil capacities, and lubrication frequency.
- A method for routine inspection (check lists).
- Notification of responsible personnel when a unit requires attention.
- A method of recording operation and maintenance history including lubrication, adjustments, preventive maintenance, and scheduled or emergency repairs.
- A method of relating the above to the cost of operation and maintenance.

OPERATOR'S NOTE: Consult manufacturer's O&M manuals before any repairs are attempted, as the manuals provide more in-depth information than this plant operation and maintenance manual. In many cases, warranties may be invalidated unless manufacturers' procedures are followed.

1.5.2 Surveillance

Equipment surveillance is chiefly a matter of constant awareness. Awareness, in this case, is knowing what the normal operating conditions are, being able to detect any departure from normal, and having the capability of identifying the probable cause or source. Use your "senses":

- VISUAL: Check equipment for damage; check for fluid or lubricant leakage; and check gauges, levels, and meters frequently.
- SOUND: Rough bearings and materials which have become trapped can often be detected by a characteristic sound.
- TOUCH: Touch is the most common method for detecting bearing and housing temperatures, checking for vibration, etc.

Establish a routine for touring the WRP on a regular basis to verify that all equipment is operating normally. This can be coordinated with regular sample collection trips and other routine actions.

OPERATOR'S NOTE: Perform an inspection when first coming on duty and again immediately prior to going off shift. The operator should note all items on a "Daily Log" and report any departure from normal modes of operation.

Part of the operator's job is to be able to respond to abnormal conditions in a manner to either correct the problem before it becomes serious or to shift to a standby unit or an alternate routing.

Develop an attitude of pride and accomplishment in keeping buildings and grounds in the best appearance and condition. Keep alert to any form of deterioration and maintain grounds and outside equipment in top shape, making regular reports on any deficiencies. Some general guidelines for housekeeping are as follows:

- The appearance of a wastewater treatment plant is generally a good indication of the efficiency with which the facility is operated. Be conscientious about the physical appearance and cleanliness of the WRP.
- Periodically hosing down the walls of the various units will prevent the buildup of unsightly solid material with the resulting production of noxious odors.
- Schedule grounds keeping, lawn mowing, shrub trimming, weeding, watering, and fertilization.
- Keep storage areas clean and organized. Equipment that is not necessary for plant operation should not be stored at the treatment plant.
- Painting is an important activity that should be done on a routine basis. This not only helps to keep up the appearance of the facilities, but it is a method of preventive maintenance as it prevents deterioration of wood and metal surfaces.

1.5.3 Lubrication

Regular lubrication for all bearings and gears is one of the most important items in preventing equipment failure. When lubricating machinery, the following three considerations are equally important:

- Do not let bearings or gears run dry. Know all the points to be lubed. Follow the manufacturer's schedule, or if operating conditions dictate, change lubrication frequency to fit operation mode.
- Do not over grease antifriction bearings, as these housings require an air space to allow for expansion and to permit running at cooler temperatures. The effect of over greasing is the same as letting bearings run dry.
- Use the right lubrication. The type and grade of lubricant is tailored to the composition of metal used in bearings and gears, and operating conditions such as running temperature.

Adhere to the detailed lubrication and maintenance instructions set forth in individual manufacturers' O&M manuals.

1.6 Related Documents

1.6.1 Manufacturer's Operation and Maintenance Manuals

Copies of manufacturers' O&M manuals were furnished by the installing Contractor. One full set is kept at the WRP in the Office Room. The full set includes:

- A multi-volume set of binders containing equipment O&M manuals.
- A single-volume binder containing electrical O&M manuals.
- A single-volume binder containing Kubota's O&M manual for all of their supplied equipment.
- A single-volume binder containing Kohler Power Systems Technical Literature for their supplied equipment.
- A single-volume binder containing various equipment warranty information.

The manufacturers' O&M manuals should be consulted for equipment specific information. Table 1-3 summarizes the contents of the manuals of equipment and mechanical information.

Table 1-3. Summary of Manufacturers' Equipment O&M Manual Contents

Volume	Equipment
1	Headworks Drum Screens
	Chemical Feed System: Pumps, Mixers, Storage
	Submersible Sewage Pumps
	Feed Forward Pumps
	WAS Pumps
	Aeration Diffuser System
	Residential Appliances: Water Heater, Washer, Dryer, Refrigerator
	Well Injection, Reuse & UV Recirculation Pumps
2	Solids/MBR Tank Air Blowers
	Electric Motors
	UV Disinfection System
	Lab Fume Hood
	Hoists and Cranes
	HVAC
3	Kubota MBR Process & System
4	Borger Rotary Lobe Pump
	Belt Drive
	Drive Systems
5	Solids Handling Submersible Pump
6	Kohler Power System Technical Literature
7	HACH samplers
	Endress+Hauser flow meters
8	Low-Voltage Circuit Breaker
	Motor Control Center
	Switchboard
9	Warranties: Blinds, Grinder Pump, UV lamps, Air Handling Equipment

1.6.2 References

References assist plant personnel in operating the treatment system efficiently, in performing accurate laboratory procedures, in troubleshooting, and quickly and safely reacting to emergencies. The following partial list of references in Table 1-4 should be a starting point to building a reference library.

Table 1-4. Recommended References

Water Environment Federation (WEF) Manual of Practice (MOP):	
MOP No. 1	Safety & Health in Wastewater Works
MOP No. 11	Operation of Municipal Wastewater Treatment Plants
Environmental Protection Agency (EPA) Manuals:	
Procedural Manual for Evaluating the Performance of Wastewater Treatment Plants, No. 68 01 0107	
Emergency Operating Procedures for Municipal Wastewater Facilities, No. 68 01 0341	
Standard Methods for the Examination of Water and Wastewater, WEF, American Public Health Association (APHA), and American Water Works Association (AWWA)	
Operation of Wastewater Treatment Plants, Ken Kerri, Sacramento State College, Department of Civil Engineering	
Sewerage and Sewage Treatment, Babbit and Boumann, published by Wiley, Inc.	

1.6.3 Record Drawings

Record Drawings for the construction of the WRP should serve as a valuable reference and as a starting point for locating buried or embedded utilities. This O&M manual frequently references pages in the drawing set as visual aids. Record Drawings should be maintained with copies of the manufacturers' manuals in the laboratory/office area and updated as necessary along with this manual.

1.7 Notes for O&M Manual

1.7.1 Directional Terms

The directional terms "plant north," "plant east," etc., are occasionally used to describe locations relative to and within the WRP proper. On this coordinate system, the headworks, for example, is north of the Operations Building and the process tanks are east of the Operations Building. See Sheet C4 of the Record Drawings.

1.7.2 Process and Instrumentation Diagrams and Equipment Tag Numbers

The process and instrumentation diagrams (P&IDs) are provided in Appendix B for operator reference and are a valuable resource for visual depictions of various processes and associated equipment. Each P&ID is a complete schematic representation, on one sheet, of a process at the WRP, making it easier to visualize and understand. Each chapter refers to the appropriate P&ID for the process discussed.

This manual refers frequently to the equipment (or tag) numbers associated with major pieces of equipment. These numbers identify equipment on the P&ID Record Drawings and in the SCADA system programming.

1.7.3 Troubleshooting and Maintenance

The manufacturers' O&M manuals should be used to find troubleshooting, maintenance, and scheduling information.

2. EPA UNDERGROUND INJECTION CONTROL PROGRAM

The Tribe's WRP utilizes Vadose Zone Injection Wells for disposal of reclaimed water, defined as Class V injection wells. The wells operate under "Authorization by Rule," allowed by the federal Underground Injection Control (UIC) Program promulgated under Part C of the Safe Drinking Water Act (SDWA). Owning or operating a Class V well requires that one cannot allow movement of fluid into underground sources of drinking water (USDW) that might cause endangerment, and must comply with the Federal UIC requirements in 40 Code of Federal Regulations (CFR) parts 144 to 147. Selected portions of CFR 144 are included in Appendix A for the operators' convenience. These are not the only portions of the CFR parts listed above that are applicable. Additionally, comply with any other measures required by the EPA Region 10 UIC Program to protect USDWs. The wells must be properly closed at the termination of their use.

Information regarding requirements for operation of Class V injection wells is included in Appendix A. Operation of the wells is described in Chapter 14, and sampling and laboratory procedures are included in Chapter 18.

3. OVERVIEW AND PROCESS DESCRIPTION OF WASTEWATER SYSTEM

3.1 Overview

This section provides an overview of the treatment processes at the WRP. Each of the system units are described in more detail in subsequent chapters dedicated to that particular component. Chapter 4 is devoted to a brief summary of the collection system. Therefore, no discussion of the collection system is contained in this chapter.

Refer to Sheet G3 in the Record Drawings for a complete record of design criteria for the WRP.

3.1.1 Site Plan and Flow Streams

Figure 3-1 shows the overall site plan for the WRP; Figure 3-2 shows the process flow diagram (PFD). More detailed process flow depictions for each process can be ascertained from the P&IDs in Appendix B. Solids flow streams are indicated by the heavier line weight.

3.1.2 Design Criteria and Hydraulic Profile

Figure 3-3 provides a hydraulic profile for the WRP. Influent design criteria are provided in Table 3-1.

Table 3-1. WRP Influent Flow and Mass Loading Design Criteria

DESIGN FLOWS (million gallons per day [mgd])	Two Trains (mgd)	Four Trains (mgd)[a]
Annual Average	0.15	0.30
Maximum Month (MM)	0.195	0.39
Peak Day	0.30	0.60
Peak Hour	0.59	1.15
PROCESS DESIGN CRITERIA – INFLUENT LOADS	**Two Trains (pounds/day)**	**Four Trains (pounds/day)[a]**
5-Day Biochemical Oxygen Demand (BOD_5) – Maximum Month Average	1,000	2,000
Total Suspended Solids (TSS) – Maximum Month Average	1,000	2,000
Total Kjeldahl Nitrogen (TKN) – Maximum Month	135	270

a Future design flows and loads require equipping of Trains 3 and 4 and the Mechanical Room.

3.1.3 Treatment Processes

The WRP is equipped with a Membrane Bioreactor (MBR) treatment process. This is a sophisticated liquids treatment process that produces Class A reclaimed water. An MBR combines secondary treatment with microfiltration to separate and retain biological solids in the system. Waste solids generated at the facility will be hauled off-site for treatment and processing.

3.1.3.1 Liquid Treatment

Raw wastewater is pumped to the Headworks through a force main from the Resort pump station. The wastewater is screened and then passes through a 3-inch fiberglass Parshall flume, where an ultrasonic level gauge measures the influent level in the flume. The flume level is then converted to flow automatically by the flow transmitter. Measured flow is then discharged to the Influent Pump Station. At initial construction, a concrete grit removal chamber is included at the headworks for installation of a future 7-foot-diameter cyclonic grit mixer drive, pump, and grit classifier.

The Influent Pump Station is designed to have a firm capacity (capacity with the largest pump off-line) of 1.18 mgd. See Chapter 6 for a detailed description of the Influent Pump Station. The Influent Pumps discharge screened flow to the Mixed Liquor Return (MLR) channel, where it mixes with mixed liquor (ML) before entering the Anoxic Tanks. In the current configuration, system equalization for peak flows will be provided by the empty tanks in treatment Trains 3 and 4. See Chapter 7 for a detailed description of the current and future plans for equalization.

When two trains are in operation, two Anoxic Tanks act in parallel upstream of the Aeration Tanks. The Anoxic Tanks are normally connected via an open sluice gate between the tanks. Flow from each Anoxic Tank is pumped to each Aeration Tank by a dedicated Feed Forward Pump. Mixed liquor from each Aeration Tank then normally flows into its downstream MBR Tank. Permeate flow is pulled through the membranes by the Permeate Pumps. Permeate is disinfected with medium pressure UV lamps and chlorinated, then flows to the Reclaimed Water Tank. A small portion of the reclaimed water is supplied to the WRP reuse water system via the Reuse Water Pump skid, and the remainder is pumped to the Vadose Zone Injection Wells by the Well Injection Pumps.

3.1.3.2 Solids Treatment

Screenings and incidental solids (rags and other debris) removed as part of the routine maintenance of the equipment are drained and disposed of as solid waste at the local landfill. Waste activated sludge (WAS) is stored and thickened in the Solids Storage Tank, then hauled off-site for treatment and processing.

3.2 Headworks

The headworks consists of two rotary drum in-channel perforated plate fine screens that remove solids greater than or equal to 2 millimeters (mm) in diameter. This is a particularly critical component of any MBR plant as the membranes can be damaged more easily than conventional treatment units by large solids and/or grit. Screenings are cleaned and dewatered in a screw conveyor that is integrated into the screening mechanism and deposited in garbage cans, the contents of which are landfilled.

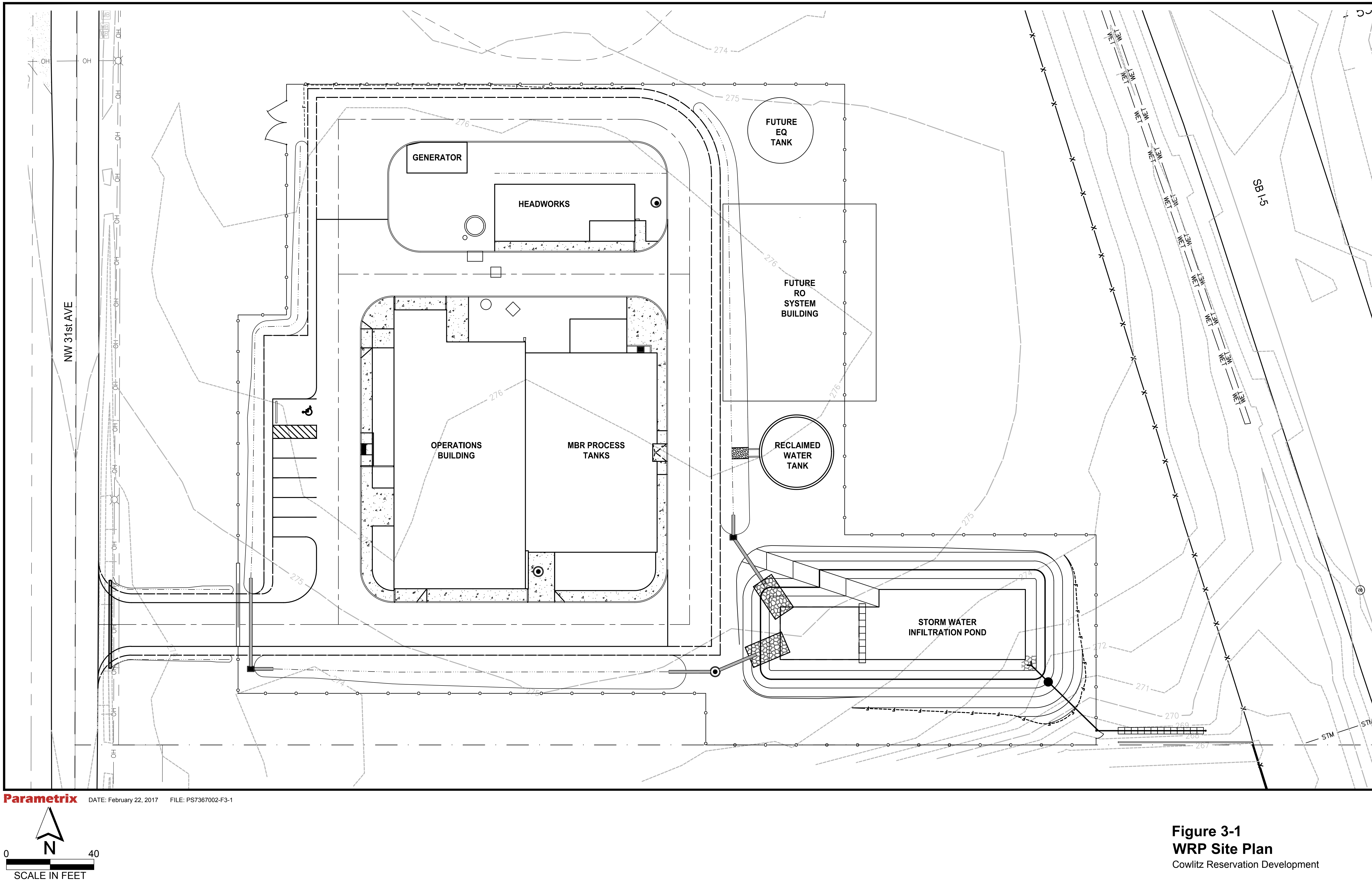

Figure 3-1
WRP Site Plan
Cowlitz Reservation Development

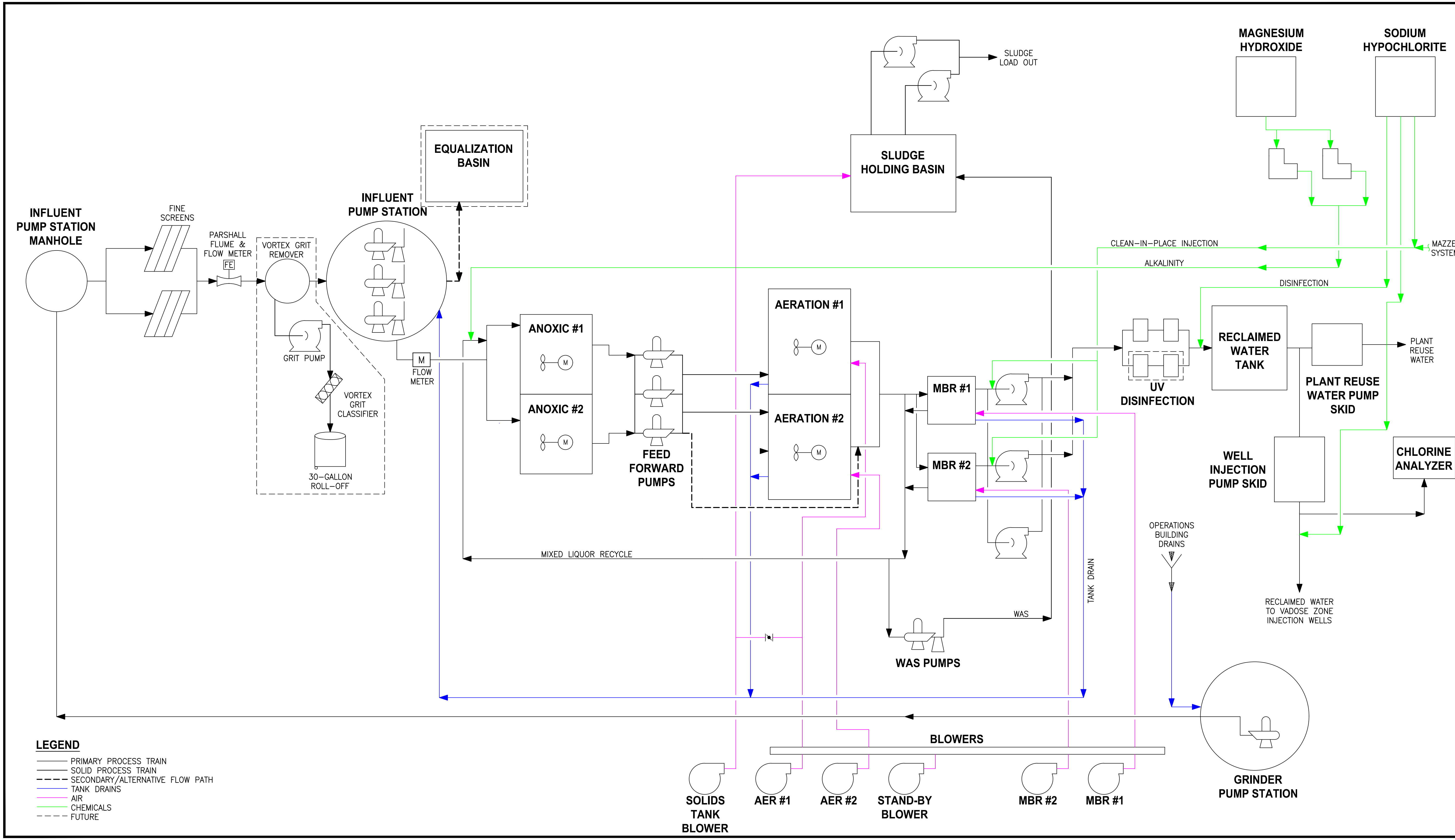

Figure 3-2
Process Flow Diagram
Cowlitz Reservation Development

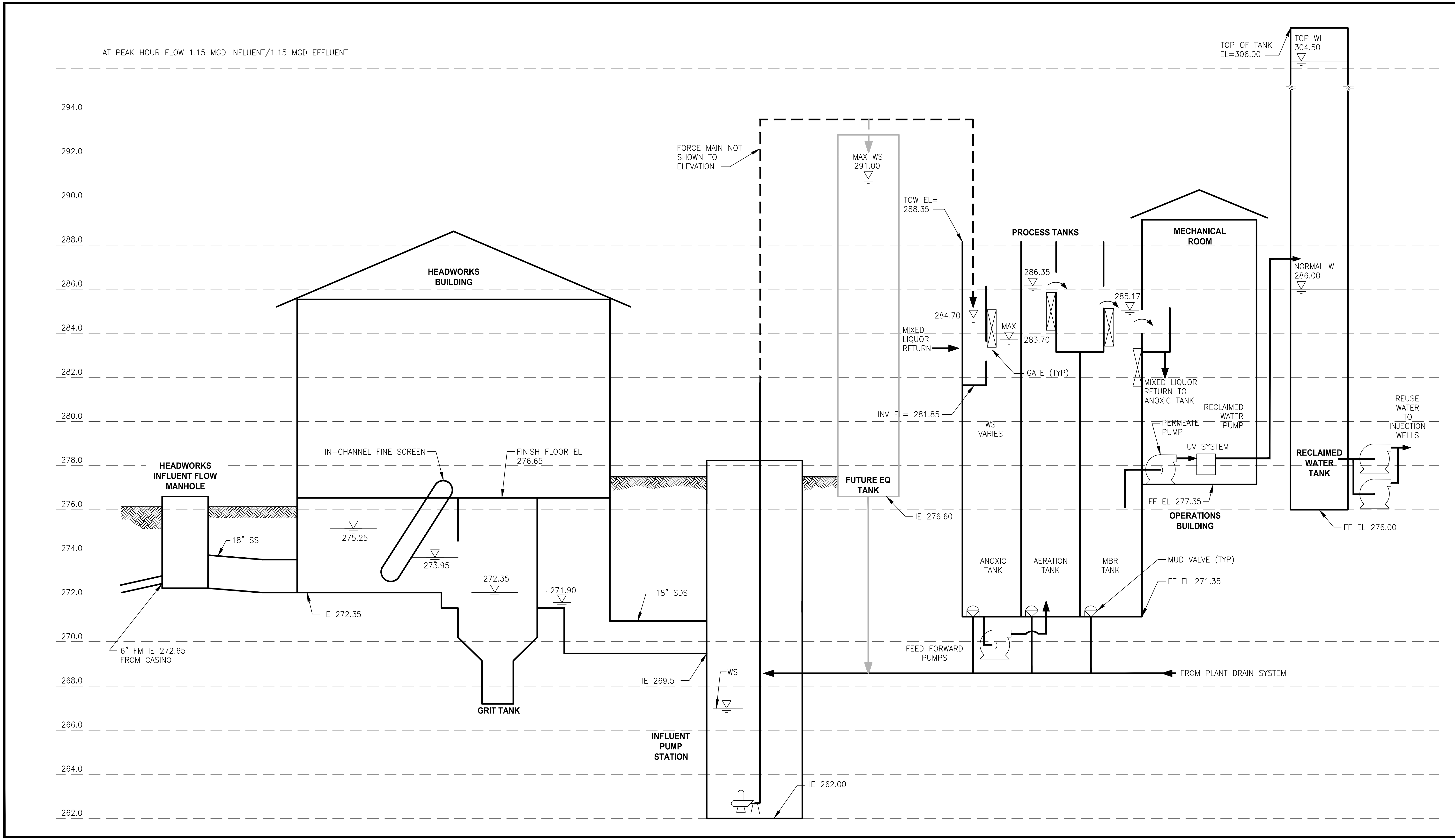

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Figure 3-3
Hydraulic Profile
Cowlitz Reservation Development

3.3 Membrane Bioreactor (MBR) Process

The MBR couples an extended-aeration activated sludge process with the filtering capability of membranes to achieve extremely high quality plant reclaimed water. Extended aeration provides a relatively long (24-day) solids retention time that allows nitrification and denitrification to occur while producing a low overall sludge yield. The MBR process consists of separate anoxic, aerobic, and filtration process steps.

In the Anoxic Tanks, screened wastewater from the headworks mixes with the recycled mixed liquor coming from the MBR Tanks. The screened raw wastewater acts as a carbon source for bacteria that converts nitrate (generated during aerobic treatment) to gaseous nitrogen products that then leaves the process water and releases to the atmosphere (denitrification).

In the Aeration Tanks, mixed liquor is aerated and kept in a well-mixed state. Under aerobic conditions, bacterial growth occurs rapidly, and this growing biomass consumes the organic material in the raw wastewater, reducing the BOD. Also during the aerobic process, Nitrosomonas bacteria convert ammonia in the waste stream to nitrite and nitrate (nitrification). This is the first step in removing nitrogen from the wastewater. The aerobic process continues in the MBR Tanks due to the coarse-bubble scour air required for proper membrane operation.

The MBR membrane modules are housed in the MBR Tanks where the membranes filter clear reclaimed water (permeate) from the mixed liquor. The membranes are flat plate cartridges that consist of membrane sheets bonded to each side of a panel. The panel keeps the membrane sheets separated, creating a clean zone between them. Clean water is drawn into the clean zone by a slight negative pressure created by the Permeate Pumps. Filtered water (permeate) passes through the membranes and out of the MBR Tank, while solids are retained in the mixed liquor. Over time, a biofilm attaches to the surface of the membranes. The biofilm acts as a “pre-filter” for the membrane material, but also can foul/blind the membranes when it becomes too thick. Bubbles of air provided by diffusers at the bottom of the MBR Tank act to scour the membrane surface and also provide some process oxygen to the system. Additional membrane chemical cleaning is also required on a periodic basis, at least twice per year, by chemical treatment systems (clean-in-place [CIP]).

3.4 Disinfection

3.4.1 UV Disinfection

Medium pressure closed vessel UV chambers are used at the WRP to meet Class A reclaimed water requirements for reclaimed water disinfection. The current system is designed to treat plant flows up to 0.56 mgd. If the UV Disinfection system fails, the sodium hypochlorite system acts as primary disinfection. In the future, a second set of 2 UV units will be added to treat higher flows and to keep head loss through the UV system at acceptable levels.

3.4.2 Sodium Hypochlorite

Sodium hypochlorite is used at the WRP for disinfection of in-plant reuse water and reclaimed water. Periodic membrane cleaning is also conducted using sodium hypochlorite. Sodium hypochlorite storage for these two systems consists of four 50-gallon, 12.5-percent solution sodium hypochlorite storage drums located in the Operations Building Chemical Room. For MBR membrane cleaning, sodium hypochlorite is blended with reuse water and diffused into MBR permeate before it enters the clean zone between the membrane sheets. Before UV-disinfected reclaimed water enters the Reclaimed Water Tank, sodium hypochlorite is injected to provide residual disinfection.

3.5 Reclaimed Water

Whatever reclaimed water is not used in the facility is pumped to the Vadose Zone Injection Wells by the Well Injection Pumps. This system is further described in Section 3.6 below.

3.6 Vadose Zone Injection Wells

3.6.1 Well Injection Pumps

The Well Injection Pump system consists of four skid-mounted pumps. The pumps deliver Reclaimed Water from the Reclaimed Water Tank to the Injection Wells at a constant pressure regardless of the flow demand. The injection pumps typically operate in the 50 to 140 gpm range, but are capable of flows up to 185 gpm. The pump speed is changed via variable frequency drives (VFDs). Injection pump control is based on maintaining a constant supply pressure to the Injection Wells.

3.6.2 Vadose Zone Injection Wells

Reclaimed water not used by the WRP is discharged by means of vadose zone injection wells. There are a total of six injection wells located in the Resort parking lot northwest of the WRP. Each well injects reclaimed water into the vadose zone through a 4-inch injection pipe that extends 160 feet below the ground surface. A VSmart valve located at the bottom of the 4-inch well casing provides flow control in the injection pipe to ensure the injection pipe is full at all times. Injection flow rates through the well screen are limited by infiltration rates of the soil. Although the valves have a closed position, there is typically a small amount of leakage.

3.7 Auxiliary Systems

This section is meant only to provide an overview of the supporting systems in the WRP. More detailed descriptions of capacity, operation, etc. are provided in Chapter 15, Auxiliary Systems.

3.7.1 Influent and Reclaimed Water Monitoring

Refrigerated, flow-paced HACH composite wastewater samplers are used for influent, reclaimed, and final water sampling. Influent samples are drawn from the channel downstream of the screens at the Headworks. Reclaimed water samples are taken by the Mechanical Room sampler at the 8-inch reclaimed water pipe downstream of the UV system, before chlorination and the Reclaimed Water Tank. In addition to the reclaimed water sampler, turbidity and nitrate analyzers are located near the Permeate Pumps to monitor MBR performance. The Well Injection Pump Room sampler will draw final reclaimed water sample from upstream of the chlorine analyzer located near the west wall of the Well Injection Pump Room.

3.7.2 Membrane Bioreactor Chemical Systems

The MBR membranes are air-scoured during permeating to keep biofilm from accumulating beyond a certain thickness and clogging the membrane pores. Occasionally, however, a more thorough cleaning with sodium hypochlorite, and possibly oxalic or citric acid, is necessary to restore the flow handling (flux) capacity of the membrane. This can be part of routine maintenance or may be necessary because of a treatment upset that has fouled the membranes. Organic fouling will be removed with a sodium hypochlorite cleaning. Reference the Kubota O&M manual or technical services regarding the circumstances under which cleanings of either type are recommended. Inorganic fouling or membrane scaling usually requires cleaning with oxalic or citric acid. Based on Cowlitz water chemistry, however, it is unlikely that oxalic or citric acid cleaning will be required.

Kubota supplied the wall-mounted CIP chemical dosing system for this facility, which primarily consists of a Mazzei eductor, a flow control valve to control plant reuse water flow, a flow meter and a pressure regulator. The unit is mounted in the Chemical Room.

3.7.3 Magnesium Hydroxide Dosing System

The WRP facility is designed to remove a large portion of the nitrogen from the wastewater. The main purpose of this is to minimize the nitrogen discharged to the groundwater via the Vadose Zone Injection Wells. The nitrogen removal process involves two main stages: 1) nitrification of ammonia from influent sewage; and 2) denitrification of the nitrates formed during nitrification. One effect of the nitrification step is that over seven parts of alkalinity are consumed for each part of ammonia converted. Without adequate alkalinity to provide buffering, the wastewater turns acidic. Acidic wastewater upsets the treatment system biology and is not good for the treatment plant equipment or the groundwater where discharge occurs. For this reason, an alkalinity dosing system was installed at the WRP to add alkalinity back into the wastewater as needed. Magnesium hydroxide ($MgOH_2$) or soda ash are the chemicals that the system is able to use. The dosing rate is set manually and can modulate according to influent flow rate.

3.7.4 Odor Control System (Future)

If the Headworks is enclosed in a building in the future, a self-contained, skid-mounted odor control system will be provided to treat odorous air ventilated from the Headworks Building. The Headworks Building will be the only source of air for the odor control system.

3.7.5 Plant Drain System and Drain Pump Station

Process tanks and the future Equalization (EQ) Tank can drain to the Influent Pump Station. The Operations Building and Utilidor drains are routed to the Grinder Pump Station. The Grinder Pump Station is an underground simplex pump and tank system located north of the Mechanical Room. The two drains that enter the Grinder Pump Station are an 8-inch drain from the Mechanical Room and a 4-inch drain from the Office and Laboratory portion of the Operations Building.

3.7.6 Reuse Water

Plant reuse water is drawn from the Reclaimed Water Tank and pumped by the reuse water system throughout the WRP to hose bibs, tank spray nozzles, screen sprays, and other process areas. The Reuse Water Pump system is a triplex pump skid system with control panel, connected to a 35-gallon hydropneumatic tank which provides storage and dampening volume to reduce pump start/stop cycling and minimize pressure surges in the reuse water system.

A 2-inch reuse water hydrant located on the north side of the Operations Building Mechanical Room is connected to the reuse water system. This hydrant can be used for filling tanker trucks with reclaimed water.

3.7.7 Equalization Tank Flushing System (Future)

A reuse water pipe has been installed for connection to the future Equalization Tank, which will be equipped with a flushing system providing pressurized reuse water to remove deposited solids. The flushing system taps off the reuse water pipe to the headworks near the northeast corner of the Operations building.

A description of the future Equalization Tank flushing system is included in Chapter 7.

3.7.8 Hoisting Equipment

A 3.5-ton bridge crane runs the length of the MBR Tanks and is primarily used to remove membrane cassettes for service.

Portable davit hoists are provided for the following equipment:

- Anoxic and Aeration Tank mixers.
- Solids Storage Tank pumps.

A 2-ton underhung monorail hoist spans from the northwest corner of the Headworks Electrical Room over the influent drum screens for lifting the screen for equipment repair and replacement. There is another motorized 1-ton, underhung monorail hoist in the Mechanical Room for lifting blower components. Chapter 15, Auxiliary Systems, provides more detailed descriptions for each system.

3.7.9 Heating, Ventilation, and Air Conditioning (HVAC) Systems

The WRP is climate controlled through the use of heat pumps, multiple unit heaters, and fans installed throughout the WRP. The following is a list of HVAC units at the WRP; equipment tag numbers, capacity, etc. are provided in Chapter 15, Auxiliary Systems.

HVAC Equipment	Location
Heater	Mechanical Room (2)
	MBR Utilidor
	Locker Room
	Toilet Rooms (1 Men and 1 Women)
	Chemical Room
	Well Injection Pump Room
Fan	Mechanical Room Ceiling Fan
	Chemical Room
	Laboratory (2)
	Locker/Toilet Rooms
Air Conditioning Unit	Headworks Electrical Room
Heat Pump	Operations Building, Administration and Laboratory Areas
	Operations Building Electrical Room

3.7.10 Shop Equipment

A full list of equipment supplied for the WRP laboratory and shop is provided in Specification Section 10610.

3.8 Electrical Systems

Refer to the E drawings of the Record Drawings for one-line diagrams and interconnection plans of the equipment. Chapter 16 also provides a more detailed description of the electrical system.

There are four Motor Control Centers (MCCs) at the Cowlitz WRP. Two are located in the Operations Building Electrical Room (MCC-201 and MCC-202), and the other two are located in the Headworks Electrical Room (MCC-203 and MCC 204). Each MCC has spare motor housings, or "buckets," to accommodate plant expansion and associated future equipment. Table 3-2 summarizes the motor starters and VFDs housed in each MCC. **Bold** indicates the motor is controlled by a VFD instead of an "across-the-line" starter. *Italics* indicates a spare bucket, for which the potential amperage and phase is provided if a future tag number is not provided.

Table 3-2. Motor Starters, VFDs, and Elements for each MCC

MCC	Equipment Motor Starter/VFD	Tag Number
MCC-201 Operations Building	Anoxic Tank 1 Mixer	MIX-21101
	Anoxic Tank 3 Mixer (Future)	*MIX-23101*
	Aeration Tank 1 Mixer	MIX-21201
	Aeration Tank 3 Mixer (Future)	*MIX-23201*
	Aeration Blower 1	**B-27001**
	Aeration Blower 3 (Future)	***B-27003***
	MBR 1 Blower	**B-27011**
	MBR 3 Blower (Future)	***B-27013***
	Standby Blower 1	**B-27100**
	MBR-1 Diffuser Cleaning Valve	FV-21301
	Feed Forward Pump 1	**P-21111**
	Feed Forward Pump 3	**P-21113**
	Feed Forward Pump 5 (Future)	***P-21115***
	Permeate Pump 1	**P-25001**
	Permeate Pump 3 (Standby)	**P-25003**
	Permeate Pump 5 (Future)	***P-25005***
	Well Injection Pump 1	**P-26531**
	Well Injection Pump 3	**P-26533**
	WAS Pump 1	P-27801
	WAS Loading Pump 1 (Future)	*P-27806*

(Table Continues)

Table 3-2. Motor Starters, VFDs, and Elements for each MCC (Continued)

MCC	Equipment Motor Starter/VFD	Tag Number
MCC-201 Operations Building (Continued)	Solids Tank Blower	B-27804
	Unit Heater, Well Pump Room	UH-28113
	Unit Heater	UH-28331
	Unit Heater	UH-28111
	Variable Air Volume Unit, Zone 1	VAV-28220
	Variable Air Volume Unit, Zone 3	VAV-28224
	Ventilation Fan	EF-28114
	Server Room Condenser	CCU-28210
	UV-1 Control Panel (CP)	CP-204A
	Site Lighting Control	E22
	Gate Operator	GT-20101
	Active Harmonic Filter	AF-201
	Strip Heaters & Transformer	MCC HEAT
	Spare	*30A/3P*
MCC-202 Operations Building	Anoxic Tank 2 Mixer	MIX-22101
	Anoxic Tank 4 Mixer (Future)	*MIX-24101*
	Aeration Tank 2 Mixer	MIX-22201
	Aeration Blower 2	**B-27002**
	Aeration Blower 4 (Future)	***B-27004***
	MBR 2 Blower	**B-27012**
	MBR 4 Blower (Future)	***B-27014***
	Standby Blower 2 (Future)	***B-27200***
	MBR-2 Diffuser Cleaning Valve	FV-22301
	MBR Crane	H-28110
	Blower Monorail Hoist 1	None
	Blower Monorail Hoist 2 (Future)	*30A/3P*
	Feed Forward Pump 2	**P-22112**
	Feed Forward Pump 4 (Future)	***P-22114***
	Feed Forward Pump 6 (Future)	***P-24116***
	Permeate Pump 2	**P-25002**
	Permeate Pump 4 (Future)	***P-25004***
	Permeate Pump 6 (Future)	***P-25006***
	Reuse Water Pump Control Panel	CP-263
	UV-2 Control Panel	CP-204B

(Table Continues)

Table 3-2. Motor Starters, VFDs, and Elements for each MCC (Continued)

MCC	Equipment Motor Starter/VFD	Tag Number
MCC-202 Operations Building (Continued)	**Well Injection Pump 2**	**P-26532**
	Well Injection Pump 4	**P-26534**
	WAS Pump 2	P-27802
	WAS Loading Pump 2	P-27807
	Variable Air Volume Unit, Zone 2	VAV-28222
	Variable Air Volume Unit, Zone 4	VAV-28226
	Unit Heater	UH-28110
	Unit Heater	UH-28112
	Water Heater	WHTR-19000
	Strip Heaters & Transformer	MCC HEAT
	Air Handler	AHU-28212
	Active Harmonic Filter	AF-202
	Lighting Panel	LP-202
MCC-203 Headworks Electrical Room	Fine Screen 1	SC-20111
	Fine Screen 2	SC-20121
	Grit Drive (Future)	*M-20202*
	Influent Pump 1	**P-20301**
	Influent Pump 3	**P-20303**
	Influent to Equalization Tank Valve (Future)	*V-20303C*
	Strip Heaters & Transformer	MCC HEAT
	Lighting Panel	LP-204
	Spare	*30A/3P*
	Spare	*20A/3P*
MCC-204 Headworks Electrical Room	*Grit Slurry Pump (Future)*	*P-20211*
	Grit Classifier (Future)	*M-20215*
	Influent Pump 2	**P-20302**
	Influent to ML Channel Valve (Future)	*V-20303D*
	Odor Control System (Future)	*OCU-20131*
	Unit Heater 1	UH-28002
	Unit Heater 2 (Future)	*UH-28003*
	Strip Heaters & Transformer	MCC HEAT
	Spare	*20A/3P*
	Spare	*20A/3P*
	Spare	*30A/3P*

3.9 Instrumentation and Control Systems

Three main control panels (CPs) are provided at the WRP: Headworks CP-210; Operations CP-201; and Kubota MBR 1 and 2 CP-202. Ten sub-control panels control subsystems: Kubota Trains 1 and 2 Anoxic and Aeration CP-202A; Kubota Trains 1 and 2 MBR CP-202B; UV Unit CP-204B; Fine Screens CP-211; Reuse Water Skid WRP CP-263; Injection Well Control Panels CP-261, CP-262, and CP-263; WAS Loading Pumps CP-278; and Chlorine Solution CP-290. One main control panel, Kubota MBR 3 and 4 CP-203, and six more sub-control panels will be added with future upgrades: Kubota Trains 3 and 4 Anoxic and Aeration CP-203A; Kubota Trains 3 and 4 MBR CP-203B; Second UV Unit CP-204A; Grit Removal System (Headworks) CP-212; and Injection Well Control Panels CP-264 and CP-265. The P&IDs supplied as part of this O&M manual in Appendix B show which equipment is connected to which control panels. Table 3-3 summarizes which equipment is controlled at which control panel.

Table 3-3. Current Control Panels and Equipment Controlled

Control Panel	Equipment Controlled
Headworks – Electrical Room	
CP-211	Fine Screen 1
	Fine Screen 2
	Fine Screen 1 Upstream Level Sensor
	Fine Screen 2 Upstream Level Sensor
	Downstream Level Sensor
CP-210	Plant Influent Flow Meter
	Grit Slurry Pump Delta Pressure Transmitter (Future)
	Grit Classifier Water Pressure Transmitter (Future)
	Grit Chamber Mixer Drive (Future)
	Influent Pump 1
	Influent Pump 2
	Influent Pump 3
	Influent Pump Station Well Level Transmitter (x2)
	EQ Mixer 1 (Future)
	EQ Mixer 2 (Future)
	EQ Tank Level Transmitter (Future)
	Odor Control Blower (Future)
	Combustible Gas Analyzer (Future)
	H_2S Analyzer (Future)

(Table Continues)

Table 3-3. Current Control Panels and Equipment Controlled (Continued)

Control Panel	Equipment Controlled
Operations Building	MLR to Influent Sewer Flow Meter
CP-201	UV Stream 1 Control Valve (Future)
	UV Stream 2 Control Valve
	WAS Feed Pump 1
	WAS Feed Pump 2
	WAS Feed Flow Meter
	WAS Loading Pump
	WAS Loading Pump (Future)
	Solids Load to Truck Flow Meter
	Solids Tank Blower
	Well Injection Pump 1
	Well Injection Pump 2
	Well Injection Pump 3
	Well Injection Pump 4
	Reuse Level Control Valve
	Reuse Potable Water Fill Solenoid
	Reuse Water Flow Meter
	Reuse Water Pressure Transmitter
	Reuse Tank Level Transmitter (x2)
CP-204A	UV Stream 1 – Reactors 1A and 1B (Future)
CP-204B	UV Stream 2 – Reactors 2A and 2B
WRP CP-263	Reuse Water Pump Skid
CP-278	Solids Tank Load Out Pumps
	Solids Tank Load Out Flow Meter
	Sludge Loading Start and Stop
CP-202	Influent Flow Meter
	Anoxic 1 Mixer and DO/Temp Probe
	Anoxic 2 Mixer and DO/Temp Probe
	Aeration 1 Mixer and DO/Temp Probe
	Aeration 2 Mixer and DO/Temp Probe
	Permeate Pumps 1, 2, and 3, All Pressure Transmitters, Solenoid Valves, Flow Meters, and Butterfly Valves
	Feed Forward Recycle Pumps 1, 2 and 3
	Feed forward Flow Meters to all MBRs
	MBR Level Switches

(Table Continues)

Table 3-3. Current Control Panels and Equipment Controlled (Continued)

Control Panel	Equipment Controlled
CP-202 (Continued)	MBRs 1 and 2 Diffuser Cleaning Valves
	All Blowers, Blower Flow Meters
	Membrane Thickener WAS Valve
	Operations Building Electrical Room Heat Pump
	Membrane Chemical Cleaning Valves
CP-280	Level Switch High-High, High and Low
	Grinder Pump
CP-202A	Anoxic/Aeration Remote I/O
CP-202B	MBR No. 1 and No. 2 Remote I/O
CP-290	Chlorine Solution (CLS) High, Low and Low Alarm Floats
Parking Lot	
CP-261	Injection Well 1 Control Valve
	Injection Well 1 Flood Switch and Intrusion Switch
	Injection Well 1 Level and Pressure Transmitter
	Injection Well 1 Flow Transmitter
	Injection Well 2 Enclosure Heater
	Injection Well 2 Flood Switch and Intrusion Switch
	Injection Well 2 Level and Pressure Transmitter
	Injection Well 2 Flow Transmitter
	Injection Well 5 Enclosure Heater
	Injection Well 5 Flood Switch and Intrusion Switch
	Injection Well 5 Level and Pressure Transmitter
	Injection Well 5 Flow Transmitter
CP-262	Injection Well 3 Enclosure Heater (not installed)
	Injection Well 3 Flood Switch and Intrusion Switch (not installed)
	Injection Well 3 Level and Pressure Transmitter (not installed)
	Injection Well 3 Flow Transmitter (not installed)
	Injection Well 6 Enclosure Heater
	Injection Well 6 Flood Switch and Intrusion Switch
	Injection Well 6 Level and Pressure Transmitter
	Injection Well 6 Flow Transmitter

(Table Continues)

Table 3-3. Current Control Panels and Equipment Controlled (Continued)

Control Panel	Equipment Controlled
Well CP-263	Injection Well 4 Enclosure Heater
	Injection Well 4 Flood Switch and Intrusion Switch
	Injection Well 4 Level and Pressure Transmitter
	Injection Well 4 Flow Transmitter
	Injection Well 7 Enclosure Heater
	Injection Well 7 Flood Switch and Intrusion Switch
	Injection Well 7 Level and Pressure Transmitter
	Injection Well 7 Flow Transmitter

The operators can observe and change operating parameters of the WRP through the graphical interfaces, also known as HMIs, located throughout the WRP. The primary interface is the SCADA HMI located in the main office.

3.9.1 Automatic Operation

Normal operation of the WRP requires placing all equipment in Automatic through the SCADA system. This also means that any HAND-OFF-AUTO (HOA) switches on the MCCs are placed in the AUTO position, and any local JOG-OFF-REMOTE (JOR) switches are placed in the REMOTE position. There are several manually operated valves and stop gates throughout the WRP but these are rare and will, under normal operations, usually be set at the fixed positions indicated in the P&ID Drawings (Appendix B).

3.9.2 SCADA Manual Operation versus Local Manual Operation

There are two methods for placing equipment in Manual operation. The first is referred to as SCADA Manual, whereby equipment is selected from the HMIs to operate in Manual as opposed to Automatic, but all process changes are still made through SCADA by the operator. SCADA Manual merely overrides automatic changes in process settings and allows the operator to set equipment operating parameters for circumstance-specific events. For example, the Feed Forward Pumps are programmed to pump at a certain flow rate based on the level in the Anoxic Tank. The operator, however, can place any Feed Forward Pump in Manual, turn it on, and adjust the desired pump flow rate at the HMI, thereby overriding the automated process.

Local Manual implies that the equipment in question has been provided with its own control panel or switch, installed either directly on or adjacent to the equipment. The operator is, therefore, physically with the equipment and is operating the equipment using only the equipment-specific controls. Typically, Local Manual is limited to use of the JOR switch associated with the equipment to turn the equipment off or on, which overrides the normally programmed operation. If the switch is placed in the JOR position, the equipment will turn on and stay on only as long as the operator is physically holding the JOR switch in this position.

It is also possible at the MCC to place any HOA switch in the HAND or OFF position, which will turn the associated piece of equipment on or off, respectively. Placing the switch in either the HAND or OFF position will prevent any automated SCADA program from engaging that piece of equipment until the HOA is placed back in AUTO. The JOR switches, if any, have to be placed in REMOTE.

OPERATOR'S NOTE: Placing the HOA switch in HAND or HMIs in Manual will allow the equipment to run indefinitely. Operators should take care that if any pumps are placed in HAND, the associated wet wells are not pumped dry, which would harm the pump motors.

4. COLLECTION SYSTEM

4.1 Overview

The WRP currently serves Phase 1 of the Resort development. A gravity sewer system, pump station, and force main (see Figure 4-1) have been constructed to serve the area. This chapter will address the collection system currently in place.

4.2 Conveyance System

4.2.1 Gravity Collection System

Flow from the Resort is collected by an 8-inch gravity sewer system, which conveys flow to a pump station located south of Northwest 319th Street west of the casino parking area. Since the collection system is new, infiltration and inflow are not expected to be excessive. The collection system will be expanded to adjacent areas of the Resort as development occurs.

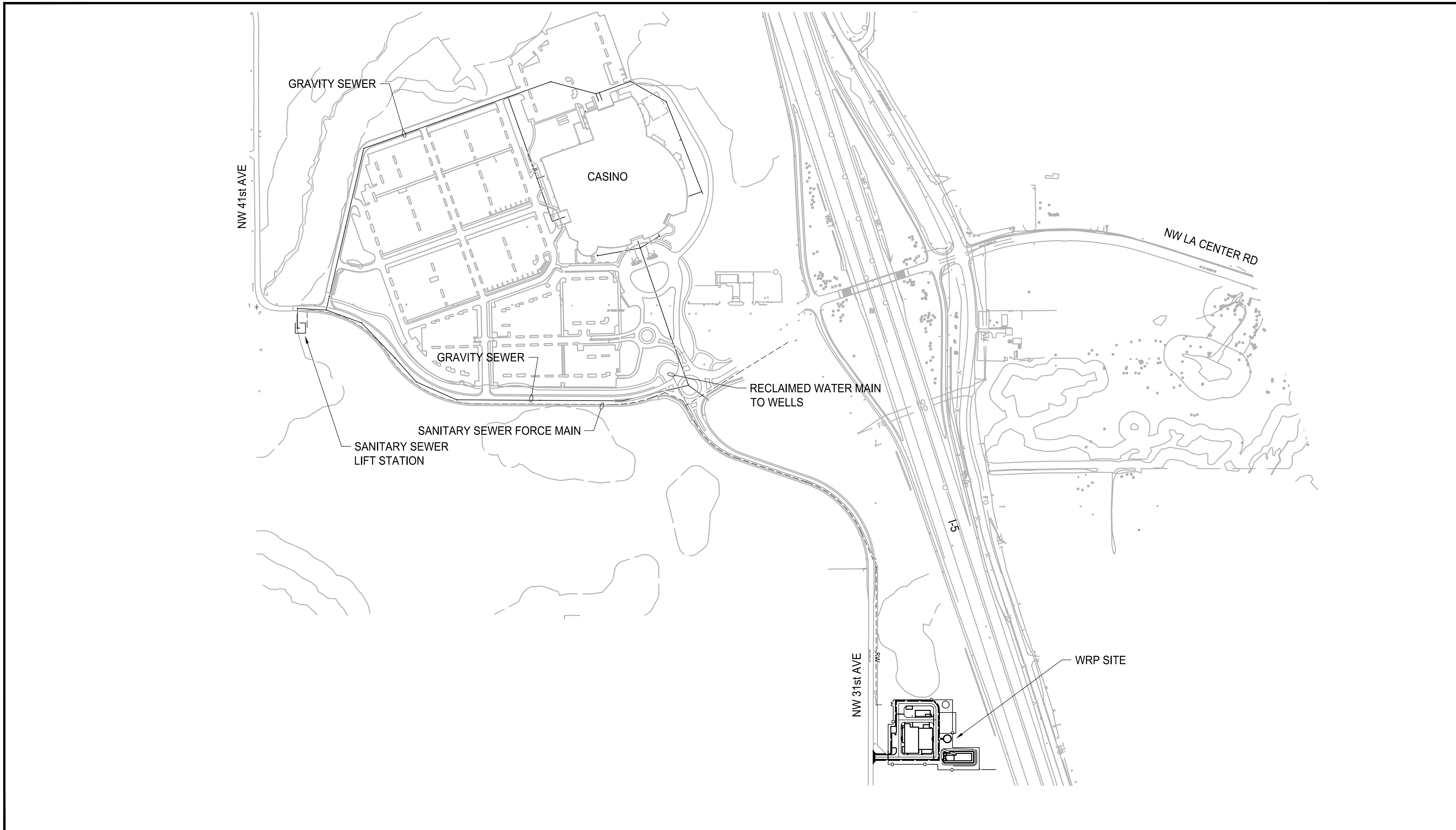
4.2.2 Pump Station

All of the flow to the WRP is pumped by the pump station through an 8-inch sanitary sewer force main. The force main runs along Northwest 319th Street and Northwest 31st Avenue, and enters the WRP site at the northwest corner (See Record Drawings Sheet C9). See the pump station O&M Manual and Record Drawings for additional information on the pump station.

4.3 Maintenance

4.3.1 Regular Operational Checks and Preventative Maintenance

All force main valves should be inspected as part of an operations and maintenance plan. Additionally, the WRP staff is responsible for maintenance of the gravity collections system and pump station.



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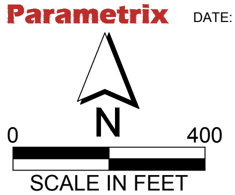

Figure 4-1
Collection System

Cowlitz Reservation Development

5. HEADWORKS

5.1 Overview

See Appendix D, Figure D-2. Refer to Sheets P2–P3 and M202–M205 in the Record Drawings for a depiction of the process flow and piping for the Headworks.

The headworks consists of screening and influent flow measurement. Provisions are also in place for future grit removal. Influent is pumped to the influent manhole at the headworks by the collections system pump station. The force main breaks head in the influent manhole located immediately east of the Headworks, and flow enters the headworks channel through an 18-inch influent pipe. The influent pipe enters the influent channel, which splits into two channels, and flows by gravity through two rotary drum fine screens with 2 mm circular openings. The split influent channels join downstream of the screens where flow travels through the influent Parshall flume flow meter, then through an open channel in the headworks floor to an 18-inch Screened Degritted Sewage (SDS) pipe. The SDS pipe conveys the influent out of the building to the Influent Pump Station.

Flow from the Parshall flume is currently blocked from entering the grit chamber by manual stop gate G-20202A. With future installation of the degritting equipment, the flows will be degritted before entering the channel to the 18-inch SDS pipe.

A 2-inch reuse water pipe enters through the Headworks slab north of the northerly drum screen (SC-20121) to provide wash water to the screens. The reuse lines are heat traced for freeze protection. Reuse water is passed through a 100-mesh wye strainer prior to being used as wash water for screens. The strainer is located immediately upstream of the screen wash water solenoid valves. A 1-inch flexible hose connects the reuse water line to the screen. This is the only filter on the reuse water line in the Headworks.

OPERATOR'S NOTE: The solenoid wash valves on the drum screens can become stuck open by debris, thereby discharging large volumes of reuse water to the system. A check that these valves are operating properly should be part of a routine maintenance schedule.

Table 5-1 provides the equipment tag numbers for the screens, grit removal system, and other major pieces of equipment.

Table 5-1. Equipment Tag Numbers for Headworks Equipment

Equipment Description	Tag Number
SCREENING	
Influent Screen 1:	SC-20111
Level Element	LE-20111
Level Transmitter	LT-20111
Influent Screen 2:	SC-20121
Level Element	LE-20121
Level Transmitter	LT-20121

(Table Continues)

Table 5-1. Equipment Tag Numbers for Headworks Equipment (Continued)

Equipment Description	Tag Number
INFLUENT FLOW MEASUREMENT	
Influent Flow Flume:	
Flow Element	FE-20220
Flow Transmitter	FT-20220
GRIT REMOVAL	
Grit Tank	T-20202
MISCELLANEOUS	
Influent Sampler	SMP-20108

5.2 Design Criteria

Table 5-2 provides design criteria for the headworks equipment.

Table 5-2. Design Criteria for Headworks Equipment

Rotary Drum Fine Screens	
Screen Opening (mm)	2
Maximum Hydraulic Capacity, per screen (mgd)	1.5
Maximum Clean Water Head Loss (inches)	16
Maximum Wash System Flow Rate (gallons per minute [gpm])	33
Motor Size (horsepower [hp])	2
Parshall Flume	
Material	Fiberglass
Throat Width (inches)	3
Length (inches)	36
Flow Range (gpm)	15 to 830
Vortex Grit Chamber	
Particle Removal Capacity	95% Removal of >50 mesh particle size 85% Removal of >70 mesh particle size 65% Removal of >100 mesh particle size
Peak Design Flow (mgd)	1.2
Trap Zone diameter, depth (feet)	7,5
Storage Sump Diameter, depth (feet)	3.5, 4.8

5.3 Screening

5.3.1 Normal Operation and Control

The fine screen and screenings compactor are used to screen, convey, and dewater influent solids of 2 mm size and larger. The unit is controlled by a level sensor in the influent channel ahead of each fine screen (LE-20111 and LE-20121).

During normal operation, plastics and solids are trapped on the inside diameter of the submerged screen basket. The trapped solids cause the screen to "blind," resulting in a rise in the upstream channel level. Regardless of the flow rate, once the upstream water level reaches the set point, the influent level sensors will activate the screen cleaning operation. Typical setpoints for the screen operation are as follows:

Start Level on Delay	5 seconds
Screen Off Time	60 minutes
Off Delay Time	30 seconds
Reverse Run Time	2 seconds
Direction Change Dwell	25 seconds
Attempts to Clear Fault	1 second
Press Zone On Time	30 seconds
Press Zone Off time	6 hours
Wash 1 Time	4 seconds (then off 2 seconds)
Wash 2 Time	4 seconds (then off 2 seconds)
Lube Pump On Time	20 seconds (then off 5 hours)

Dewatered screenings are deposited in a wheeled canister which requires periodic emptying by the operator.

5.3.2 Automatic Operation

For automatic operation:

1. At the Field Control station, place the HAND-OFF-REMOTE selector in the REMOTE position.
2. At the Fine Screen Control Panel, place the HAND-OFF-AUTO selector in the AUTO position.
3. At the HMI on the control panel, select screens to operate in the AUTO position.

5.3.3 Manual Operation

For manual operation:

1. At the Fine Screen Control Panel, turn the screen ON by placing the HAND-OFF-AUTO selector switch in the HAND position.
2. At the Fine Screen Control Panel Control Station, turn the screen ON by placing the HAND-OFF-REMOTE selector switch in the REMOTE position.

5.4 Emergency Operation and Control

5.4.1 Headworks Alarm List

See Appendix C.

5.4.2 Equipment Failure

5.4.2.1 Fine Screens

If one screen fails, the other screen is capable of treating all incoming flow. The operator can divert influent to the working screen, if needed, by closing the normally open stop gate upstream of the failed screen (G-20111A or G-20121A).

As there is no bypass around the screens, if a screen fails, the operator must ensure that the failed screen does not blind and that influent does not overflow on the floor.

It is highly unlikely that a catastrophic failure of both screens will occur. In the event that this does happen, the operator should open both channels and leave the screens in place to remove material as long as possible. A pressure washer could also be used to clean the screens manually until normal operation can resume. However, if this not possible, the screens can be pivoted out of the channels to prevent blinding. **Rags and other debris can damage or clog the Influent Pumps and damage the membranes. Allowing unscreened influent in the MBR Tanks will void the membrane warranty**. Until the future degritting equipment is installed, flow could be routed through the degritting tank by opening Stop Gates G-20202A and G-20202B and closing Stop Gate G-20201, which could allow some material to settle in the grit tank before entering the Influent Pump Station. If both screens are malfunctioning and are pivoted out of the channel, the operator should make every effort to route all flows to EQ Storage (See Chapter 7), and keep raw influent from entering the equipped process tanks. Any equipment that comes into contact with raw influent will have to be thoroughly cleaned and the debris removed after the emergency event has passed.

OPERATOR'S NOTE: Allowing unscreened influent to contact the MBR membranes must be avoided at all costs. Warranty provisions will be violated immediately.

5.5 Start-Up/Shut-Down Procedures

Upon start-up from either power source (serving utility or standby generator), there is a 10-second delay between the starts of screens. Following a power failure or transfer between sources, screens restart automatically when power is restored. All equipment in the Headworks can operate on the standby generator.

5.5.1 Screening

For periods when maintenance is required, the fine screen drum may be raised out of the channel with use of the monorail hoist to a horizontal position and blocked up. A hoist is provided to assist in maneuvering the equipment. Before pivoting the screen drum out of the channel, the operator should close the influent and reclaimed water gates for the screen being serviced, turn off wash water at the main block valve, and disconnect the wash water supply at the screen being serviced.

5.6 Maintenance

SAFETY NOTE! Channel areas of the Headworks are Class 1, Division 1 Hazardous Locations. Exercise caution when working on equipment in this area.

5.6.1 Regular Operational Checks

During normal flows, operators should check the fine screens for excessive blinding, including watching a full wash cycle to ensure that the wash-water solenoid valve is opening and the screens are being washed properly. Operators should check all solenoid valves in the Headworks to ensure that the valves are opening on a timed cycle.

6. INFLUENT PUMP STATION

6.1 Overview

The Influent Pump Station is designed to have a firm capacity (capacity with the largest pump off-line) of 1.18 mgd, and a maximum capacity of 1.52 mgd. The Influent Pumps discharge screened flow to the MLR channel, where it mixes with mixed liquor before entering the Anoxic Tanks.

The minimum normal operating water level in the Influent Pump Station is approximately 3.0 feet from the bottom of the wet well. The pumps were factory tested and provided the following flows:

- Pump 1: 410 gpm at 40 feet TDH
- Pump 2: 410 gpm at 40 feet TDH
- Pump 3: 410 gpm at 40.2 feet TDH

The approximate minimum speed setting is 50 percent of motor speed. At the high level set point of 8 feet from the bottom of the wet well, the minimum continuous flow would be about 100 gpm (0.14 mgd).

The Influent Pump Station is detailed in the Record Drawings on Sheets P4 and M201.

Table 6-1 provides the equipment tag numbers for the pumps and major pieces of equipment.

Table 6-1. Equipment and Equipment Tags for Influent Pump Station

Equipment Description	Tag Number
Influent Pump 1	P-20301
Influent Pump 2	P-20302
Influent Pump 2	P-20303

Each submersible Influent Pump system consists of its own discharge elbow, guide rail, check valve, and VFD.

6.2 Design Criteria

Table 6-2 summarizes the design criteria for the Influent Pumps.

Table 6-2. Design Criteria for Influent Pump Station Equipment

SEWAGE PUMPS	
Pumping Condition A – Rated Capacity at Full Speed	
Capacity (gpm, each pump)	410
Total Head (feet)	39
Minimum Hydraulic Efficiency (percent)	66
Approximate Pump Speed (rpm)	1,750

(Table Continues)

Table 6-2. Design Criteria for Influent Pump Station Equipment (Continued)

Pumping Condition B – Reduced Speed	
Capacity (gpm, each pump)	250
Total Head (feet)	26
Minimum Hydraulic Efficiency (percent)	57
Approximate Minimum Speed (rpm)	930
General Requirements	
Minimum Shut-Off Head (feet)	68
Minimum Hydraulic Efficiency at Best Efficiency Point (percent)	66
Minimum Noncompressible Solids Passage (inches)	2.0
Minimum Motor Horsepower	7.5

6.3 Normal Operation and Control

6.3.1 Continuous Level Control Mode

See Appendix D, Figure D-3.

With the HAND-OFF-AUTO (HOA) switch on the VFD operator interfaces placed in the AUTO positions, the three pumps will be controlled automatically by CP-210 based on the wet well level transmitters and the PLC to maintain a nearly constant wet well level, currently set at 5.5 feet. During Continuous Level Control mode, the number of pumps operating and the pump speeds are varied by a proportional-integral-derivative (PID) control loop in the PLC to maintain a constant level in the wet well. When the pumps are first engaged, the pumps will start at the speed set by the PID controller. This will most likely be the minimum pump speed; however, the pumps will not maintain the minimum speed for an extended period of time. The pumps will operate in Continuous Level Control mode unless a failure of the system occurs.

In Continuous Level Control mode, pumps are automatically staged and speeds varied to maintain water surface elevation in the wet well at a near constant level. Flow velocity within the influent sewer is thus maintained at a level that keeps solids in suspension, reducing accumulation of material within the pipe. At the same time, surcharging of the influent sewers is minimized. This level will prevent “waterfalls” and splashing which tends to create odor and air entrainment in the wet well.

Upon failure of a pump or VFD to engage, the PLC will start the next pump in the sequence. The lag pump will go to lead, standby to lag, and a pump failure alarm will be issued for the pump that failed to engage.

6.3.2 Rising Wet Well Level

As influent flow into the pumping station wet well increases, the water level begins to rise and lead and lag pumps are turned on one at a time as necessary to match the flow. On rising wet well level, the lead (first) pump is turned on. The lead pump will ramp up in speed as the water level rises. Speed of the lead pump is then varied by its VFD to maintain the water level as near the set point as practical without “hunting.”

Should the influent flow rate to the pumping station exceed the capacity of the lead pump (or the lead pump is clogged or fails), the wet well level will continue to rise until the lag pump will be started and both pumps will match speed to maintain the wet well level.

If the influent flow rate to the pumping station continues to exceed the capacity of the lead and lag pumps together, the wet well level will continue to rise and a high level alarm will be initiated and sent to the operators. **The standby pump will not operate automatically unless the lead or lag pump fails to operate.**

6.3.3 Falling Wet Well Level

As the wet well level begins to decrease, the pump drive speed feedback is used to turn off the pumps. As lead and lag pumps slow commensurate with flow, the second pump is turned off when it reaches 55 percent speed, or the minimum speed as determined by the tests described above. All pumps turn off when the minimum wet well level is reached.

OPERATOR'S NOTE: The wet well level should not normally be allowed to drop below 3.0 feet because of possible damage to the pumps.

6.3.4 Pump Alternation

To maintain equal wear on pumps and motors, two modes of alternating the running order of the Lead/Lag/Standby pumps are provided on the HMI: Automatic and Manual.

When Automatic Alternation is selected, the PLC alternates the pump sequence in order to equalize total run times of each pump. Alternation will occur once each day, at a time selected by the operator. The motor with the lowest run time will become the lead pump, the second lowest will be the lag pump, and the pump with the highest number of hours will be the standby pump. When Manual Alternation is selected, the operator may select the order of alternation and it will remain that way until the HMI is returned to Automatic Alternation. This mode may be used when a pump is out of service.

6.3.5 Manual Mode

Any or all pumps may be operated manually by placing the HOA switch on the VFD operator interface in the HAND position. The speed of that pump can then be set on the VFD operator interface. A pump that is operating in MANUAL mode is not controlled by the PLC. However, any pump that remains in REMOTE mode will continue to be controlled by the PLC.

In MANUAL mode, the operator must use caution to prevent the wet well from being pumped down below minimum pump submergence. At this elevation, the control panel (CP 210) will trigger a local warning alarm and the LOW WET WELL LEVEL call-out alarm.

6.4 Sequence of Operation

6.4.1 Automatic Operation

At the VFD operator interface, place the HAND-OFF-AUTO selector in the AUTO position.

At the HMI on the control panel, select Automatic Alternation of Lead/Lag/Standby for Pumps P-20301, P-20302, and P-20303, or manually select Lead/Lag/Standby pump order.

At the HMI on the control panel, select Automatic for Pumps P-20301, P-20302, and P-20303.

The pumps start, stop, and vary speed automatically to maintain preset water surface elevations in the wet well and minimum speed criteria of the pumps.

6.4.2 Manual Operation at the VFD

At the VFD, turn the pump ON by placing the HAND-OFF-AUTO selector switch in the HAND position.

The pump operates at the last selected speed. At the VFD, adjust the speed desired using the VFD operator interface UP and DOWN arrows.

6.4.3 SCADA Manual Operation

At the HMI on the control panel, select desired influent pump to operate in MANUAL mode. The JOR switch remains in REMOTE.

6.5 Emergency Operation and Control

6.5.1 Pump Failure

If the PLC calls a pump to run and does not receive a RUNNING confirmation signal from the VFD, the PLC will issue an INFLUENT PUMP X GENERAL FAULT alarm (X = the pump number). If the system is operating normally in Automatic mode, upon failure of any pump, the next pump in line will be enabled as the water level rises to its set level.

Moisture sensing in any pump triggers an INFLUENT PUMP X MOISTURE DETECTED IN MOTOR alarm to alert operators only to the maintenance condition, but will not affect operation. High motor temperature in any pump will trigger an INFLUENT PUMP X MOTOR OVER TEMP alarm, stop the motor, and disable it in all modes of operation until the fault has been cleared at the VFD.

Upon start-up from either power source, serving utility, or standby generator, there is a 10-second delay between the starts of first and second pumps and between the second and third pumps. Following a power failure or transfer between sources, pumps restart automatically in staggered fashion when power is restored.

6.5.2 Pump Station Alarm List

See Appendix C.

6.6 Start-Up/Shutdown Procedures

6.6.1 Operation at Start-Up

Refer to the manufacturer's O&M manual for specific instructions regarding pump installation and checks that should be made prior to initial operation of the pump.

Each influent pump is equipped with an HOA switch that should be placed in Automatic at MCC-203 or MCC-204 for start-up. There are no local control switches for any of the influent pumps that require setting.

6.6.2 Operation at Shutdown

During a temporary shutdown, the pump remains installed and is not disconnected from the electricity supply. Under these conditions, the pump should remain completely submerged to protect against freezing.

6.7 Maintenance

Any and all maintenance performed on the pumps should be verified with the manufacturer's O&M manual. Warranty requirements could be violated if improper procedures are followed; consult the manufacturer's manual for more detailed maintenance schedules.

SAFETY NOTE! The interior of the Influent Pump Station wet well is a Class 1, Division 1 Hazardous location because of the potential accumulation of hazardous gasses. An envelope 1.5 feet high and 3 lateral feet from the edge of the pump station hatch is considered Class 1, Division 2; and the pump station vent is considered either Division 1 or Division 2, depending on the size of the radius. Operators should take precautions when working around or maintaining equipment in the pump station and follow confined space entry procedures.

6.7.1 Operational Checks

The power consumption and voltage of the pumps should be monitored periodically for all three phases. An increase or a decrease in power draw beyond typical operational fluctuations can indicate damage and/or faulty operation of the impeller, bearings, and/or the motor. A closely followed schedule of checks will familiarize the operator with what average operational variability he or she can expect and what constitutes abnormal power consumption.

The manufacturer also recommends periodic checks of the insulation resistance to ensure that moisture has not penetrated the cable and/or motor; and checks of the lifting cables, cable holders, and functional aspects of the safety devices. Finally, the discharge pressure gauges can be used to check the pump performance; this requires knowledge of normal operating conditions against which the pressure reading can be evaluated.

7. EQUALIZATION FOR PEAK FLOW DIVERSION

This chapter discusses equalization (EQ) of influent flows. Additional EQ storage for reclaimed water is provided in the Reclaimed Water Tank and discussed in Chapter 13.

7.1 Overview

The Influent Pump Station is designed to pump the ultimate four-train treatment flows, so it is unlikely that two-train flows will exceed the capacity of this pump station. This flow capacity could, however, create issues for the downstream process. In the current configuration, system equalization will be provided by the empty Anoxic and Aeration Tanks in treatment Trains 3 and 4. If the influent flow exceeds the two-train plant capacity, excess flow from the Influent Pump Station will cause the level in the Anoxic Tanks and MLR channel to rise and overtop Gate G-23307, and the excess flow will enter the unequipped Train 3 and 4 Anoxic Tanks. Temporary pipe spools located in the walls between the Anoxic and Aeration Tanks in Trains 3 and 4 allow flow to pass from the Anoxic Tanks to the Aeration Tanks, providing the full EQ storage capacity of all four tanks. Under normal operating conditions, the Trains 3 and 4 MBR Tanks will not be used for EQ.

OPERATOR'S NOTE: If MLR channel overflows to Trains 3 and 4 due to large influent flows, a portion of the MLSS will also overflow to these trains. Kubota recommends that the MBR Tank MLSS concentration be over 6,000 mg/L when permeating. See the Kubota O&M manual for more details about permeate flow limits at MLSS concentrations less than 9,000 mg/l.

Because there are currently no Feed Forward Pumps in Trains 3 and 4, and the Anoxic Tanks do not have drain valves, a temporary 8-inch pipe spool has been provided in the wall between each Anoxic and Aeration Tank in Trains 3 and 4. The spools, shown on Sheet S312 of the Record Drawings, are located 1 foot above the tank floors. Once the peak flow event is over, the equalization storage from the Train 3 and 4 tanks can be gradually drained back to the Influent Pump Station through the WRP drain system.

OPERATOR'S NOTE: If the Aeration and Anoxic Tanks fill to 15 feet deep, flow will automatically cascade to the MBR Tanks providing additional storage volume.

In the future, when equipment is installed in treatment Trains 3 and 4, the temporary pipe spools between the Anoxic and Aeration Tanks in Trains 3 and 4 will be capped, and equalization will be provided by an above-ground equalization tank constructed northeast of the headworks. Operators will have the ability to divert excess flows from the Influent Pump Station to this tank using motorized valves located in the roadway south of the Headworks. When the high flow event dissipates, the Equalization Tank would then be gradually drained back into the Headworks manhole.

See Sheet P4 of the Record Drawings for a schematic of the future Equalization Tank and the flow routing for interim use of Trains 3 and 4 for equalization storage. See Sheets S302, S312, and M303 for detail of the flow routing and drainage of equalization storage in Trains 3 and 4.

OPERATOR'S NOTE: The Trains 3 and 4 tanks currently used for flow equalization are not equipped with mixers or aerators. Untreated sewage stored in the tanks has a high potential for turning septic and producing foul odors. Equalization storage in Trains 3 and 4 should be kept to the shortest duration possible, and the tanks should be drained and cleaned as soon as practical after a peak flow event.

7.2 Design Criteria

Table 7-1 provides design criteria and EQ storage capacities for the Trains 3 and 4 Anoxic and Aeration Tanks.

Table 7-1. Design Criteria for Trains 3 and 4 Equalization

Anoxic Tank (Each Tank)	
Length (feet)	19[a]
Width (feet)	17
Depth (feet)	17
Maximum EQ Storage Side Water Depth (feet)	15
EQ Storage Volume (gallon)	40,500
Detention Time at Maximum Month and Peak Day Flow, respectively (hours)[b]	10.0, 6.5
Aeration Tank (Each)	
Length (feet)	15[a]
Width (feet)	17
Depth (feet)	17
Maximum EQ Storage Side Water Depth (feet)	15
EQ Storage Volume (gallon)	33,190
Detention Time at Maximum Month and Peak Day Flow, respectively (hours)[b]	8.2, 5.3
MBR Tank[c] (Each)	
Length (feet)	14
Width (feet)	17
Depth (feet)	17
Maximum EQ Storage Side Water Depth (feet)	13.8
EQ Storage Volume (gallon)	24,680
Detention Time at Maximum Month and Peak Day Flow, respectively (hours)[c]	6.1, 3.9

[a] Both Anoxic and Aeration Tanks include volume under the entrance/exit channels.

[b] Detention time assumes all flow is routed to equalization. Times will increase if the WRP is continuing to function.

[c] MBR Tanks are not used for EQ under normal conditions. See Section 7.4, Emergency Operation.

Using only the Trains 3 and 4 Anoxic and Aeration Tanks for equalization, a total of 149,000 gallons of EQ storage are available, which equates to approximately 24 hours of flow storage at two-train Maximum Month Design Flow, and 15.7 hours of flow storage at two-train Peak Day Design Flow, if all flows are routed to equalization.

7.3 Normal Operation and Control

Trains 3 and 4 can be used to temporarily hold peak flows that are greater than the two-train design capacity of the WRP. Under peak flow conditions, part of the MLR channel flow will automatically go over the gate/weir G23307 in the MLR channel to EQ storage in Trains 3 and 4. Before this occurs, the water level will trigger high level alarms in Anoxic Tanks 1 and 2. No other functions of the current EQ system are automatic, and there is no automated control system for EQ in Trains 3 and 4. Filling and emptying of Trains 3 and 4 is accomplished as described in the following sections. Refer to the Operator Note under Section 7.1 regarding dilution of MLSS concentration when using this EQ.

7.3.1 Filling

If the flow from the Influent Pump Station exceeds the two-train plant capacity, excess flow will cause the level in the Anoxic Tanks and MLR channel to rise and overflow Gate G-23307. The excess flow will then enter the Train 3 and 4 Anoxic Tanks via the MLR channel. When peak flows decrease, the level in the MLR channel will recede, and the MLR channel will function normally (all flow going to Anoxic Tanks 1 and 2).

If all flow must be diverted from the equipped process tanks to EQ in Trains 3 and 4, follow the procedure described below in Section 7.4, Emergency Operation.

To allow full use of Trains 3 and 4 volume for equalization, a temporary 8-inch pipe spool has been provided in the wall between each Anoxic and Aeration Tank in Trains 3 and 4. The spools, shown on Sheet S312 of the Record Drawings, are located 1 foot above the tank floors. These spools will allow flows entering the Anoxic Tanks to also flow to the Aeration Tanks, providing the full storage capacity of all four tanks. For equalization purposes, these tanks can be filled to a maximum side water depth of approximately 15 feet, which is the normal operating level of the Aeration Tanks. If additional EQ storage is required, follow the procedure described below in Section 7.4, Emergency Operation, to use the unequipped Train 3 and 4 MBR Tanks for additional storage.

OPERATOR'S NOTE: Trains 3 and 4 are not currently equipped with any form of automated level sensing or alarms. When flows are routed to Trains 3 and 4 for EQ storage, the tank levels should be constantly monitored by an operator until the peak flow event recedes. Any time that flows are routed to Trains 3 and 4 for EQ storage, portable pump(s) should be staged near the tanks to allow for rapid implementation of the Emergency Operation procedures.

SAFETY NOTE! The trains 3 and 4 tanks should be considered confined spaces, and, when filled with sewage, each tank and the area extending 18 inches above the tank top and 10 feet horizontally from the tank walls is classified as a Class 1, Division 2 Hazardous Location. Operators should use proper procedures and caution when working in and around these tanks because of the possibility of accumulated sewer gases.

7.3.2 Draining

Once flow rates decrease, the equalization storage in the Trains 3 and 4 tanks can be gradually drained back to the Influent Pump Station through the WRP drain system. To drain the EQ storage, open the mud valves in the Aeration Tanks; the tanks will drain by gravity to the Influent Pump Station through an 8-inch drain pipe shown on Sheets M309 and M201 of the Record Drawings. The operator should monitor the flow rate of the Influent Pump Station while draining the tanks and adjust the mud valves as needed to ensure that the flow drained from equalization does not exceed the capacity of the Influent Pump Station or the MBR treatment process.

The Trains 3 and 4 Aeration Tanks should drain nearly completely by gravity; however, the Anoxic Tanks will only drain to within 1 foot of the bottom due to the location of the temporary pipe spools to the Aeration Tanks. The final foot of EQ storage in the Anoxic Tanks must be pumped to an unequipped Aeration Tank (or MLR channel) using a portable pump and drained through the Aeration Tank mud valve. There are sumps located in the corners of the Anoxic Tanks (see Sheet M303 of the Record Drawings for locations) to allow the tanks to be completely emptied.

Once the tanks are drained of wastewater, the Anoxic Tanks should be hosed clean, with the wash water pumped to an unequipped Aeration Tank. The Aeration Tanks should then be hosed clean, drained through the mud valves, and the mud valves closed.

7.4 Emergency Operation

7.4.1 All Influent Routed to EQ

In the case of catastrophic screen failure described in Chapter 5, or any other failure where influent cannot be routed to the equipped process tanks, Gate G-23307 can be opened completely and Gate G-21307 closed, preventing all influent from entering the Train 1 and 2 process tanks. All influent flow is then diverted to the Train 3 and 4 Anoxic Tanks via the MLR channel. If this operation is necessary, the operator must be aware of the storage volumes and detention times shown in Table 7-1, and the level of EQ storage in the tanks must be continuously monitored.

7.4.2 Insufficient Storage in Anoxic and Aeration Tanks

If it appears that the combined volume of the Anoxic and Aeration Tanks in Trains 3 and 4 will not be adequate to contain a flow event, the wastewater could automatically flow to the MBR Tanks once the wastewater level reaches a side water depth of approximately 14 feet-3 inches in the Aeration Tanks. For equalization purposes, the MBR Tanks can be filled to a maximum depth of approximately 15 feet. The two MBR Tanks can provide a total of approximately 49,000 gallons of additional EQ storage if necessary. Once the peak flow event is over, the MBR Tanks can be drained by gravity through the WRP drain system using the MBR Tank mud valves.

The side water storage depths indicated in Table 7-1 are the approximate maximum depths that will allow the WRP to continue operating under normal hydraulic conditions. In an extreme emergency, a side water elevation of up to 16 feet could be used for storage, leaving approximately 1 foot of freeboard. In this condition, however, the MLR channel will not flow properly by gravity, and numerous alarms will be triggered. The operator will also need to be cautious about diluting the process MLSS concentration (See Section 7.1 for more information).

7.5 Maintenance

7.5.1 Preventative Maintenance

The unequipped tanks in Trains 3 and 4 will sit empty and idle for extended periods of time. While there is no equipment currently associated with these tanks other than gates and valves, proper maintenance is critical to operation if equalization is needed. Gates G-21307 and G-23307 should be checked regularly to ensure they are clean and unobstructed. The mud valves in the aeration and MBR Tanks should be regularly exercised and lubricated in accordance with manufacturer recommendations described in the manufacturer’s O&M Manual.

After each EQ event, the tanks should be thoroughly cleaned and drained, and the temporary 8-inch spools between the Anoxic and Aeration Tanks should be checked to ensure they are free of obstructions.

SAFETY NOTE! The Trains 3 and 4 tanks should be considered confined spaces, and, when filled with sewage, each tank and the area extending 18 inches above the tank top and 10 feet horizontally from the tank walls is classified as a Class 1, Division 2 Hazardous Location. Operators should use proper procedures and caution when working in and around these tanks because of the possibility of accumulated sewer gases.

8. BIOLOGICAL TREATMENT TRAIN-ANOXIC AND AERATION TANKS

8.1 Overview of the Biological Process

The secondary, or biological, systems in wastewater plants are the most important treatment mechanisms for removing polluting constituents from wastewater streams, particularly carbonaceous biochemical oxygen demand (BOD) and nitrogen. The Cowlitz WRP biological system is designed to remove nitrogen through a nitrification/denitrification process.

Screened degritted sewage entering the treatment trains is first pumped into the MLR channel where it mixes with return mixed liquor before entering the Anoxic Tanks, and serves as a source of substrate (food) for denitrifying microorganisms. Wastewater is then pumped by the Feed Forward Pumps from the Anoxic Tanks to the Aeration Tanks, which provide air to both mix tank contents and supply oxygen to the aerobic microorganisms responsible for BOD removal and nitrification. This mixture of biomass and wastewater is referred to as mixed liquor.

After a sufficient detention time in the Aeration Tanks, the microbes metabolize most of the organic matter in the wastewater, using it for food and the generation of more biomass. Ammonia is also microbially transformed in the aeration process to nitrate and nitrite. The mixed liquor then flows by gravity to the MBR Tanks, where the biomass and other inert solids are filtered out by drawing only treated reclaimed water through the membranes. Nitrate-rich mixed liquor exits the MBR Tanks by dropping over the discharge weir and into the MLR channel back to the Anoxic Tanks at a flow rate six times that of WRP influent flows. The Feed Forward Pump speed is operator-adjusted and not controlled by the actual influent flow rate. In the Anoxic Tanks, microorganisms use the oxygen associated with the nitrate molecules. Nitrogen gas is generated as a by-product of the microbial utilization of nitrate, and is then released to the atmosphere. This is how nitrogen is removed from the wastewater.

Excess biomass is periodically wasted from the MBR process by pumping a portion of the MLR flow to the Solids Tank. Wastage rates are based on maintaining the desired microbial concentration in the MBR processes. In conventional activated sludge systems, the Aeration Tanks typically contain about 2,500 to 3,000 milligrams per liter (mg/L) of mixed liquor suspended solids (MLSS); however, MBRs are designed to operate at much higher MLSS concentrations of 8,000 to 11,000 mg/L.

This chapter will examine in more detail the anoxic and Aeration Tanks at the WRP; because the MBRs are a fairly complex system, an entire chapter is devoted to MBR process and controls descriptions.

The basic things to understand about the MBR system are:

- Permeating (MBR filtration) must not occur without air scour.
- Filtration can occur for limited periods at the minimum air scour rate (as long as permeability is acceptable).
- Minimum permeability should be maintained at all times.
- Maximum transmembrane pressure (TMP) must never be exceeded.
- Air scour can be provided without permeating.

8.2 Anoxic Tanks – Overview

Refer to Sheets M303-M307, P5, and P6 of the Record Drawings for a depiction of the piping and process flow for the Anoxic Tanks.

The Anoxic Tanks are designed to provide both denitrification of nitrified wastewater and some high flow equalization. Screened influent enters the MLR channel where it mixes with the mixed liquor as it flows by gravity to the Anoxic Tanks. Anoxic Tank submersible mixers operate continuously whenever the Anoxic Tanks are in service to keep the Anoxic Tank microorganisms well-stirred without introducing oxygen to the mixed liquor. Anoxic Tanks 3 and 4 have been constructed, but no equipment has been placed in the tanks. These Anoxic Tanks would operate in parallel with Trains 1 and 2 when future flows require expansion. Reclaimed water from Anoxic Tank 1 is normally pumped by the Feed Forward Pump to Aeration Tank 1. Feed Forward Pump rate is controlled by the MBR system (operator adjustable) and is normally 6Q (6 times monthly average influent flow rate). The Feed Forward Pump capacity of 474 gpm per pump is based on MM flow of 195,000 gpd x (6+1). If the Anoxic Tank liquid level exceeds either the high or low water level alarms, this condition would override the flow matching control.

During low wastewater flows, or when the Aeration Tanks are taken off-line for maintenance, the Feed Forward Pumps can pump directly to the Aeration Tank discharge channel (and MBR Tanks), thereby bypassing the Aeration Tanks. Slide gates on the Aeration Tank side of the aeration channel must be closed during this bypass operation. Both Anoxic Tanks have sumps (see Drawing M303) where portable submersible pumps can be placed to drain the bottom 2 feet of the tanks that the Feed Forward Pumps cannot remove.

OPERATOR'S NOTE: If an Anoxic Tank is emptied, note that before refilling the tank and starting the Feed Forward Pumps, air trapped in the pump suction pipe must be released. The manual air release valves on the pump suction pipes are provided for this purpose. Operating the pumps without removing all the air could damage the FF Pumps.

Flow pumped from the Anoxic Tanks is recorded by FE-21211 and FE-22212, and pumped bypass flow to the Aeration Tank channel is recorded by FE-21311. The Feed Forward Pump flow to the Aeration Tanks is controlled by a Kubota MBR control system.

An important process parameter is that actual "anoxic" conditions (DO less than 0.5 mg/L) exist in the tanks. The DO level is a critical parameter on which denitrification depends. The MBR Tanks are aerated for membrane scouring purposes (and process aeration), and consequently, membrane aeration during low flow/load results in higher mixed-liquor DO levels returning to the Anoxic Tanks. This excess DO will be used up from incoming wastewater oxygen demand; however, it is necessary for the operators to monitor and make sure that anoxic conditions are occurring in the tanks at all times.

The Anoxic Tank level is the control parameter for permeate and feed forward flow control. If the Anoxic Tank level reaches low or high level set points, the system will override any flow match control.
Table 8-1 provides the equipment tags for major equipment associated with the Anoxic Tanks.

Table 8-1. Equipment Tag Numbers for Anoxic Equipment

Equipment Description	Tag Number
Influent Mag Flow Meter	FE-20303
Anoxic Tank 1 Mixer:	MIX-21101
• Moisture Element	ME-21101
• Temperature Switch	TSH-21101
Anoxic Tank 2 Mixer:	MIX-22101
• Moisture Element	ME-22101
• Temperature Switch	TSH-22101
Aeration Tank 1 Feed Forward Flow Meter	FE-21211
Aeration Tank 2 Feed Forward Flow Meter	FE-22212
Aeration Tank Bypass Feed Forward Meter	FE-21311
Oxidation-Reduction Potential (ORP) Probe, Anoxic 1	AE-21106
Dissolved Oxygen/ Temperature Probe, Anoxic 1	AE-21107
pH probe, Anoxic 1	AE-21105
Oxidation-Reduction Potential (ORP) Probe, Anoxic 2	AE-22106
Dissolved Oxygen/Temperature Probe, Anoxic 2	AE-22107
pH probe, Anoxic 2	AE-22105

8.2.1 Design Criteria

The Anoxic Tanks were sized based on the following WRP maximum monthly average (MMA) design criteria: nitrogen loading, denitrification rate at 10 degrees C, MLSS concentration, and internal recycle ratio. Based on the calculations, the minimum required hydraulic detention time at MMA daily flow of 0.195 mgd would be 1.2 hours. Table 8-2 provides design criteria for the Anoxic Tanks and associated equipment.

Table 8-2. Anoxic Tank Design Criteria

Anoxic Tanks	
Length (feet	19
Width (feet)	17
Depth (feet)	17
Side Water Depth (feet)	12.35
Operational Volume, total for two tanks (gallons)	68,000
Detention Time, at maximum month plus MLR recycle ratio of 6Q (hours)	1.20
Mixers	
Type	Submersible
Number	2
Motor	2.3 hp, 460 V, 3-phase, 60 Hz
Flow Meters	
Type	Magnetic flow meter
Range (gpm)	0 to 500
Signal	4 to 20 mA

Note: Volt = V Hertz =Hz milliampere = mA

8.2.2 Normal Operation and Control

The two influent slide gates associated with the Anoxic Tanks are manually operated. The submersible mixers and Feed Forward Pumps are controlled by the Kubota MBR control system and are equipped with HAND-OFF-AUTO switches at MCC-201 and MCC-202, located in the Operations Building Electrical Room.

8.2.2.1 SCADA Manual Operation of Mixers

For manual operation of the mixers:

1. At the MCC, place the HAND-OFF-AUTO selector in the AUTO position.
2. At the HMI on the control panel, select mixers to operate in the HAND position.

8.2.2.2 Local Manual Operation at the Motor Control Center (MCC)

At the MCC, turn the Mixer ON by placing the HAND-OFF-AUTO selector switch in the HAND position.

8.2.3 Emergency Operation and Control

8.2.3.1 Anoxic Tank Alarms

Moisture sensing in any submersible mixer triggers an ANOXIC TANK X MIXER SEAL FAIL DETECTED alarm to alert operators only to the maintenance condition, but will not affect operation. High motor temperature in any mixer will trigger an ANOXIC TANK X MIXER OVERTEMP DETECTED alarm, stop the motor, and disable it in all modes of operation until the fault has been cleared.

8.2.3.2 Equipment Failure Workarounds

If a mixer in one of the Anoxic Tanks fails, a spare can be installed quickly and easily. It is recommended that a repair kit or shelf-spare be kept at the WRP. If absolutely necessary, a mixer from one of the Aeration Tanks can be used temporarily.

8.2.4 Start-Up/Shutdown Procedures

The only equipment associated with the Anoxic Tanks that require any start-up or shut down is the mixers. There is a 10-second delay at start-up from either power source (serving utility or standby generator) between the starts of mixers. Following a power failure or transfer between sources, the mixers restart automatically when power is restored.

8.2.5 Maintenance

Although the Anoxic Tanks receive screened influent, it is recommended that the tanks be taken off-line once a year for draining and cleaning. The tanks are designed to be isolated so that one can be taken off-line while the other is still in service. Denitrification volume will be reduced during Anoxic Tank cleaning, which may lead to a temporary elevation in the reclaimed water total nitrogen concentration.

SAFETY NOTE! The interior of the Anoxic Tanks to the top of the tank wall and extending 18 inches above the tank top is classified as a Class 1, Division 2 Hazardous Location. This classification also extends to an envelope 18 inches above grade and 10 feet horizontally from the tank walls. Operators should use caution when working in and around the Anoxic Tank because of the possibility of accumulated sewer gases.

8.2.5.1 Regular Operational Checks

The mixers are a critical component of the Anoxic Tanks. Operators should conduct daily visual checks to both ensure that the mixers are on and that the mixers are maintaining a good mixing pattern in the Anoxic Tanks.

It is also critical to the denitrification capacity of the anoxic zones to maintain a DO level of no greater than 0.5 mg/L in the tanks. DO probes are installed in the Anoxic Tanks, and it is recommended that the operators check the Anoxic Tank DO and ORP as part of a daily routine. The operators should also occasionally check DO levels with a handheld DO probe at various points in the tanks, to check the efficiency of mixing in the tank and identify possible points of short-circuiting. At a minimum, the following should be tested:

- At the point(s) where mixed liquor enters the system.
- At the tank corners.
- At the mixers.

The Anoxic Tank also has pH and ORP instruments. The pH sensor is important for sensing low pH conditions and determining if adequate magnesium hydroxide is being added to the process. The ORP sensor can be used as a tool to check the denitrification action and ensure this process step is going efficiently.

8.3 Aeration Tanks – Overview

Refer to Sheets M303, M305, P5, and P6 of the Record Drawings for a depiction of the piping and process flow for the Aeration Tanks and aeration discharge channel. Sheet P13 also provides information on the blowers for the Aeration Tanks.

Each Feed Forward Pump is dedicated to its Anoxic Tank and both pumps should pump equal mixed liquor flows from the Anoxic Tanks to each of the two Aeration Tanks operated in parallel. Another set of Feed Forward Pumps will need to be installed for operation of the future treatment Trains 3 and 4. Manual slide gates in the aeration discharge channel need to be closed to isolate each Aeration Tank during low flow conditions or maintenance needs. Each Aeration Tank is equipped with a bank of fine bubble tube diffusers, which are connected to a dedicated blower for each tank.

The blowers are in the Mechanical Room of the Operations Building. DO concentration and temperature in Aeration Tanks 1 and 2 are continuously monitored by AE-21205 and AE-22205, respectively. Dedicated Aeration Tank blowers are incorporated into a DO-control loop with the DO probes suspended in the tanks, where blower speed is automatically modulated to maintain tank DO at the operator-defined set point. When the DO increases beyond the operator-adjustable high DO set point, and the blowers are at minimum speed, the blowers will shift to a stop mode until the DO declines below another operator-adjustable set point, at which point the blower starts at a minimum air flow output.

The current DO set point for the Aeration Tanks at start-up is 3.0 mg/L because nitrification was not being completed; however, operator judgment and existing conditions at the WRP will determine whether this is the most appropriate long-term setting. It is recommended that the set point be changed to 2.0 mg/L once full nitrification stabilizes. Under most circumstances, DO should be maintained in the tanks between approximately 1.0 to 2.0 mg/L to maintain conditions for full nitrification without over-aeration.

Submersible mixers run when aeration is off in the Aeration Tanks to keep flows continuously mixed and also to provide mixing in the event of any diffused aeration loss or during periods when the DO loop drops the blowers to little or no aeration. The aeration-mixing system employs a main air header and lateral piping system to distribute air throughout the tank. The diffusers are designed to provide uniform air distribution.

Flow from each Aeration Tank gravity flows to the aeration discharge channel and then to the MBR Tanks through the MBR inlet weirs.

Table 8-3 summarizes equipment tag numbers for the major equipment associated with the Aeration Tanks.

Table 8-3. Equipment Description and Tag Numbers for Aeration Tanks

Equipment Description	Tag Number
Aeration Blower 1:	B-27001
• Pressure Indicator	PI-27001
• Temperature Indicator	TI-27001
• Temperature Switch	TSH-27001
Aeration Blower 2:	B-27002
• Pressure Indicator	PI-27002
• Temperature Indicator	TI-27002
• Temperature Switch	TSH-27002
Aeration Tank 1 Mixer:	MIX-21201
• Moisture Element	ME-21201
• Temperature Switch	TSH-21201
Aeration Tank 2 Mixer:	MIX-22201
• Moisture Element	ME-22201
• Temperature Switch	TSH-22201
Aeration Tank 1 DO/Temperature Element	AE-21205
Aeration Tank 1 DO/Temperature Transmitter	AIT-21205
Aeration Tank 2 DO/Temperature Element	AE-22205
Aeration Tank 2 DO/Temperature Transmitter	AIT-21205
Aeration Tank 1 Level Transducer	LSL-21202
Aeration Tank 2 Level Transducer	LSL-22202
Slide Gates to MBR Tank 1	G-21204 and G-21304
Slide Gates to MBR Tank 2	G-22204 and G-22304

8.3.1 Design Criteria

The diffuser system is sized for aeration to meet DO requirements during maximum month organic loading and to provide 1 mg/L DO in the tank during peak day design loading.

Table 8-4 provides design criteria for the Aeration Tanks and associated equipment.

Table 8-4. Design Criteria for Aeration Tanks

Aeration Tanks	
Length (feet)	15+
Width (feet)	17
Depth (feet)	17
Side Water Depth (feet)	15
Operational Volume, total for two tanks (gallons)	57,200
Detention Time, at maximum month (hours)	1.2
Design MLSS (mg/L)	9,429
Blowers	
Type	Rotary Lobe
Number	2
Motor	30 hp, 460 V, 3-phase, 60 Hz
Operating Pressure (psig)	8.7
Capacity (scfm)	489
Mixers	
Type	Submersible
Number	2
Motor	2.4 hp, 460 V, 3-phase, 60 Hz

Note: scfm = cubic feet per minute at standard conditions

8.3.2 Normal Operation and Control

8.3.2.1 Aeration Tank Flow

Flow from the Anoxic Tanks is pumped to each Aeration Tank by the Feed Forward Pumps in the utilidor. Aeration Tank discharge is controlled by weirs at the tank discharge channel, whether one or two Aeration Tanks are in service. The number of Aeration Tanks needed will depend on influent loading and process conditions. During low wastewater flows or when the Aeration Tanks are taken off-line for maintenance, both Feed Forward Pumps can pump to the Aeration Tank discharge channel, thereby bypassing the Aeration Tanks. Slide gates on the Aeration Tank side of the aeration channel must be closed during bypass operation.

8.3.2.2 Aeration Blowers

Automatic (Normal) Operation

In fully automatic operation, blowers will ramp up or down depending on the DO set point. To set the DO level:

1. Select process settings from the HMI.
2. Select Aeration Tanks.
3. Select the desired Aeration Tank DO via the Kubota control system.

To place the blowers in automatic:

1. Place the local HAND-OFF-REMOTE switch to REMOTE.
2. At MCC-201 or MCC-202, place the HAND-OFF-AUTO selector for the desired blower(s) in the AUTO position.
3. At the HMI on the control panel, select blowers to operate in AUTO.

SCADA Manual Operation

At the HMI on the control panel, select blowers to operate in Manual. The JOR switch remains in REMOTE.

Local Manual Operation

Any of the blowers can be locally operated from MCC-201 (Aeration Blower 1) or MCC-202 (Aeration Blower 2) by placing the respective blower HOA switch in HAND or OFF, which permits the blowers to run indefinitely or turns the blowers off respectively. The HOA can also be used to turn the blowers off (OFF) or to run the blowers temporarily (HAND) while the operator is physically standing at the piece of equipment. Automatic control of the blowers is normally based on the DO level in the Aeration Tank.

8.3.2.3 Mixers

The mixers in the Aeration Tanks are the same as those in the Anoxic Tanks, but are designed to operate only when aeration is off. Mixers may also be operated intermittently if desired by the operator. Refer to Section 8.2.2 for operation and control instructions.

8.3.3 Emergency Operation and Control

8.3.3.1 Equipment Failure Workarounds

The operator should work to repair and bring any failed mixers online as soon as possible, but the mixers are not as critical as the aeration system. Mixer failure does not necessitate any shutdown of the Aeration Tank system.

The standby blower (B-27100) can be brought online if a dedicated Aeration Tank blower fails. It is unlikely that both an aeration blower and the standby blower will fail simultaneously. However, flow from both Anoxic Tanks can be diverted temporarily to one Aeration Tank by closing the Feed Forward Pump valve to one tank and opening the other so both Feed Forward Pumps pump to the in-service Aeration Tank. **This mode of operation is only recommended for an emergency situation.** The out-of-service Aeration Tank discharge slide gate must also be closed. The mixer in the failed tank should be kept running in order to maintain some level of mixing and keep solids in suspension.

8.3.4 Start-Up and Shutdown Procedures

To start the blowers, completely open all valves in the air supply system, including blower shutoff valves and header valves. Failure to completely open all valves may result in over pressuring the blower unit, release of the pressure relief valve, motor overload, or poor air distribution in the aeration system with the potential of over pressuring the diffuser units and damaging the diffuser membranes. Once valve positions have been confirmed, the blower may be started using the blower manufacturer's recommended start-up procedures. The aeration diffuser manufacturer recommends that initial pressure surge be reduced through a pressure relief valve (PRV) or blow-off valve.

8.3.4.1 Aeration Blower

The control of the aeration blowers is a function of which Aeration Tanks are in service and the DO concentrations in the tanks.

At initial start-up or during low BOD loadings, both Aeration Tanks may be bypassed and the MBR Tank aeration system would provide all the aeration for the process. For this situation, both the aeration blowers would remain out of service. The system can also be operated with only one Aeration Tank in service. If a blower has been out of service for some time, ensure the following:

- The machine is filled with oil to the proper level.
- Drive belt alignment and tensioning are correct.

When restarting positive displacement blower units, the start-up pressure surge should be reduced by down-weighting the PRV or operating the blow-off valve. Once the blower is operational, reset the PRV or slowly close the blow-off valve over a 5- to 10-minute period. The PRV must be set properly to prevent overloading of the blower system. Operate the manual condensate drain devices provided. If the PRV releases air for an extended period of time, the relief setting and air system should be checked.

8.3.4.2 Diffusers

There are no start-up or shutdown procedures for the diffusers that are not addressed by the blower system requirements. Diffusers can be damaged by sudden pressure increases after a prolonged period of dormancy, so blower start-up is critical. The manufacturer recommends a continuous air supply to the diffusers for maximum efficiency, so operators should minimize the time unscheduled air loss to the diffusers occurs.

8.3.4.3 Mixers

Refer to Section 8.2.2 for mixer instructions.

8.3.5 Maintenance

8.3.5.1 Blowers

Good air filtration is required with all diffuser units. The blower system is equipped with inlet filters having a performance efficiency of 99 percent removal of 2-micron particles to prevent clogging of the diffuser membrane. The inlet filters of the blower system should be changed when the inlet filter head loss reaches 10 to 15 inches water column over the initial pressure difference (check manufacturer's O&M manual). The pressure loss across the filter can be monitored with the filter restriction gauge, located on the front of the blower enclosure in the center of a column of gauges on the right-hand side of the blower housing. Improper maintenance of the air-filtering system may overload the blower system due to a high inlet loss or may result in reduced filtration efficiency which could lead to diffuser clogging.

8.3.5.2 Diffusers

The airflow to the diffuser units must be kept within the design ranges to maintain the structural and operating characteristics of the diffuser membrane. Continuous application of high airflows, greater than denoted for normal operation, may result in physical damage to the diffuser membrane.

The diffuser membranes should be protected from petroleum products, i.e., mineral oils and aromatic hydrocarbons. As a result of biological and/or inorganic materials building up on the membrane surface, pressure build-up and/or increased head loss may be experienced over a long period of operation. Typically, rubber membrane diffuser units will require cleaning every 1 to 2 years because of two common types of surface build-up: biological and inorganic scaling. Biological build-up is a moss-like growth. The recommended cleaning procedure is to physically dislodge the growth either by gently brushing the substance off or by using low pressure hosing. Care should be taken not to abrade the rubber membrane surface during the cleaning procedure. Inorganic scaling is a granular mineral-like precipitate that can form on the membrane surface. If brushing and hosing the diffuser membrane do not remove the scaling, contact the manufacturer for further instructions.

8.3.5.3 Regular Operational Checks

The aeration-mixing system is designed to provide uniform aeration. The manufacturer (EDI, Inc.) of the fine bubble diffuser system in the Aeration Tanks recommends that the air supply to the diffusers be continuous in order to maximize efficiency. Each Aeration Tank should be drained to a few inches above the diffusers, visually checked, and then check with air flow on every diffuser.

Positive dissolved oxygen concentrations should be present throughout the entire system during normal operation. A dissolved oxygen profile analysis may be used to confirm the performance of the aeration system. Typically, the dissolved oxygen levels are measured at the inlet, the outlet, and the midpoint locations of each tank to determine the aeration system performance.

Operators should also perform a visual check of the aeration system pattern as part of routine plant walkthroughs to ensure that there are no aeration dead zones in the tanks and that the aeration pattern is uniform.

Condensation will accumulate in the blower aeration piping due to the cooling of the air on the walls of the pipe. A manual condensate drain valve assembly has been provided to remove this accumulation from the pipe while the system is in operation. On a monthly basis, open the ball valve on the drain. Allow the water to exit through the valve until only air remains. Close the ball valve once the purging process has been completed.

9. BIOLOGICAL TREATMENT TRAIN – MEMBRANE BIOREACTOR (MBR) TANKS

9.1 Overview

Refer to Sheets P6–P8 of the Record Drawings for process diagrams and Kubota's Drawings M501-1 to M505 for mechanical piping details. Record drawings M308 and M312 are also a good reference for permeate and Chlorine Solution pipes layout.

There are two operational MBR Tanks. Four guidelines to remember:

1. Filtration cannot occur, without a minimum MBR air scour rate.
2. A minimum permeability should be maintained at all times.
3. The maximum TMP rating must not be exceeded.
4. Membranes should always be kept wet once they are submerged.

Membranes are submerged in a tank where the filter media separate solids in the mixed liquor from water, producing clean effluent, or permeate. The rate at which permeate is produced per area of membrane material is referred to as flux. As flux increases, the amount of dewatered solids at the membrane surface also increases and forms a biofilm. The pressure required to filter water through the biofilm and the membrane pores is called transmembrane pressure (TMP).

Kubota MBR systems prevent increases in biofilm density and reduce membrane fouling by operating at low TMP. However, TMP is also a function of flow and increases as flow increases. Therefore, to normalize the relationship between flow (flux) and TMP, the ratio of these two parameters (flux/TMP) is defined as permeability and is monitored and used for controlling membrane performance. Within typical operating ranges, permeability changes linearly with flux or TMP. Monitoring permeability allows an operator to trend one number as a measure of performance and eliminates any confusion when comparing TMP values at different flows or at different times. Moreover, slight changes in TMP can significantly change permeability making it easier to compare operating conditions and monitor membrane performance.

The MBR Tanks operate individually or in parallel. The influent mixed liquor flow from the Aeration Tanks is split between the MBR Tanks based upon the weir levels at the entrance to each MBR Tank (in the aeration discharge channel). Because the water level in the MBR Tanks does not vary much, the permeate flow control is based on the water levels in the Anoxic Tanks. Although the water level in the Anoxic Tanks does vary, the permeate flow stays similar to the influent flow rate. Activated sludge that flows into the MBR Tanks is separated from the clean water by membrane filtration. The Permeate Pump system creates suction to pull the clean permeate through the membranes. The permeate flows from the Permeate Pumps to the UV disinfection units and Reclaimed Water Tank which provides disinfection contact time for sodium hypochlorite. The permeate flow is controlled by the Kubota control system set points and operators are strongly advised to familiarize themselves with the operational description of the system provided in Kubota's operations manual.

Each MBR Tank contains four Membrane Modules, so each tank has four permeate pipes that each join to a single header pipe at each MBR Tank. Dedicated Permeate Pumps, located next to the MBR Tanks in the Operations Building Mechanical Room, are connected to these permeate suction headers. The Kubota control system controls the VFD speed for each pump regulating permeate flow. Section 9.3.2 of this chapter is devoted to describing the permeate system in more detail, including tag numbers for all associated equipment. Equipment descriptions and tag numbers for the MBR Tanks are shown in Table 9-1.

Table 9-1. Equipment Description and Tag Numbers for MBR Tanks

Equipment Description	Tag Number
Slide Gate from Aeration Tanks (See Table 9-3)	G-21304 and G-21204
Slide Gate from Aeration Tanks (See Table 9-3)	G-22204 and G-22304
MBR 1 Blower	B-27011
• Pressure Indicator	PI-27011
• Temperature Indicator	TI-27011
• Temperature Switch	TS-27011
• Temperature Sensor High	TSH-27011
MBR 2 Blower	B-27012
• Pressure Indicator	PI-27012
• Temperature Indicator	TI-27012
• Temperature Switch	TS-27012
• Temperature Sensor High	TSH-27012
MBR 1 Level Sensor	LE-21304
• Level High	LSH-21303
• Level Low	LSL-21302
MBR 2 Level Sensor	LE-22304
• Level High	LSH-22303
• Level Low	LSL-22302

Permeate from each tank passes through a tank-specific turbidimeter and is collected in an 8-inch permeate pipe. The 8-inch pipe connects to the UV units that provide disinfection. Downstream of UV disinfection, sodium hypochlorite is injected to provide residual disinfection before the flow goes to the Reclaimed Water Tank, the Well Injunction Pumps, and finally to the Vadose Zone Wells. Disinfection is further described in Chapter 12.

Dedicated MBR blowers provide continuous air scour of the membrane surface to prevent accumulation of biofilm beyond design limits. Each MBR Tank is equipped with a main aeration header which supplies scour air to each bank of cassettes through four individual PVC pipes. The pipes feed air to coarse-bubble diffusers on which the cassettes sit and which are designed to bubble air between each membrane plate. The Kubota system has settings for low, medium, and high air scour rates. Based on permeate flow, air flow rates change to medium or high if permeate flow increases. The diffusers themselves are kept clean by an automated scouring with mixed liquor using a Venturi process: an automated cleaning valve on the primary aeration header opens, which stops flow through the smaller PVC pipes and allows the static head of the mixed liquor to backflow into the diffusers. The force of the air in the primary aeration line creates a Venturi effect across the diffuser openings which scours any solids accumulation and removes any blockages from the diffuser orifices. The combination of mixed liquor and air is pulled back through the individual pipes to the common header, through the automated cleaning valve, and out of the open end that extends above the MBR Tank. The scour liquid is simply discharged back to the tank as mixed liquor.

Operator note: The minimum air flow rate to each MBR is 300 cfm. Do not set a minimum lower than this rate without contacting Kubota first.

Mixed liquor mixes with the screened influent in the MLR channel. This mixture then flows to the Anoxic Tank where flow is split by the anoxic influent weirs. Feed Forward Pumps then lift the mixed liquor to the Aeration Tanks. The majority of the mixed liquor is recycled to the Anoxic Tanks for denitrification; the rest is pumped by a small waste activated sludge pump to the Solids Storage Tank.

The level in the Anoxic Tanks controls what mode the MBRs operate in; this is explained more thoroughly in Section 9.3.

Table 9-1 summarizes equipment tag numbers for the major equipment associated with the MBR Tanks; the valves and pumps associated with the permeate system are included in Section 9.3.2, Permeate Flow Control.

9.2 Design Criteria

Table 9-2 outlines design criteria for the MBR systems.

Table 9-2. MBR Design Criteria

MBR Tanks	
Length (feet)	14
Width (feet)	17
Depth (feet)	15
Side Water Depth at Max Month Q (feet)	13.8
Operational Volume, each (gallon)	24,600
Recommended Maximum above start-up TMP (psig)	2
Approximate Design Flux (gallons per square foot [gal/foot^2] at 15 degrees C)	16.4
Nominal Peak Capacity (gal/foot^2 at 15 degrees C)	32.1
Membrane Area per Tank (foot^2)	12,780
Design MLSS (mg/L)	11,000
Blowers	
Type	Rotary Lobe
Number	2 (+ 1 stby)
Motor	20 hp, 460 V, 3-Phase, 60 Hz
Operating Pressure (psig)	7.5
Capacity (scfm)	455
Permeate Pumps	
Type	Positive Displacement
Number (for MBR Tanks)	2 (+ 1 stby)
Motor	4 hp, 460 V, 3-Phase, 60 Hz
Capacity (gpm)	227

9.3 Normal Operation and Control

The operator should be familiar with the Kubota Operations and Maintenance Manual and the different MBR Tank operational modes. Control of permeate flow, drawn from the MBR Tanks, is based on water level in the Anoxic Tanks. Feed forward flow rate is set by the operator and should be approximately 7 times the average influent flow rate.

MBR Tanks are normally both in service. When the MBR system sees flow drop below the Low Flow set point for a predefined interval, the MBR tanks are switched to Nap mode (see Section 9.3.1 below for a description of the operating modes). When the calculated permeate demand increases above the Low Flow set point, tanks are placed back into Production mode.

The MBR Tanks are currently programmed to operate together. This decreases the flow to each tank and therefore creates less stress on the membranes and associated equipment.

OPERATOR'S NOTE: At no time should any MBR be permeating when its scour blower is off. Doing so will result in irrevocable damage to the membrane and poor effluent quality. Operators should never attempt to manually force any permeate production unless scour blowers are operational and on. The standby blower can be used for air scour when a dedicated MBR blower is out of service.

9.3.1 MBR Modes

The following modes of operation are established by Kubota based on water level in the Anoxic Tank, influent flow, and operator selection.

Offline Mode – All automated equipment and valves supporting the offline MBR are turned off or closed, but instrumentation remains online. Manual operations in this mode require operator interaction at the HMI interface, equipment control panel, or MCC. An MBR may be placed offline from the HMI Interface.

Sleep State – Sleep State is the same as Off-line state but the MBR blower runs intermittently to provide ML agitation and mixing. This state can only be selected by the operator by selecting "Sleep Mode."

Relax State – Permeate flow is temporarily stopped at any set point in Filter mode for the Relax Cycle. During Relax, the PLC temporarily stops filtration while membrane air scouring is continued. The system cycles in and out of Relax on an operator adjustable cycle. Relax Cycle duration is typically 1 minute. Relax frequency is the time from the beginning of one Relax Cycle to the beginning of the next Relax Cycle; typically 10 minutes.

Production Mode – In Filter mode the system is operating normally and filtering permeate through the membranes. The WRP permeate flow rate is automatically controlled by the PLC based on water level in the Anoxic Tanks. If membrane fouling is indicated by low permeability, the operator should respond and correct.

The WRP operator will enter permeate flow set points for the following flow conditions:

> **Filter Low** – This is the minimum flow set point in Filter mode. The permeate system operates at Low Flow when Anoxic Tank level reaches low level. <u>The Low Flow set point is approximately 75 percent of the maximum month average rated plant throughput.</u>
>
> **Filter Medium** – This is the Medium Flow set point in Filter mode. The permeate system operates at Medium Flow when the Anoxic Tank is between the low and high level set points. <u>The Medium Flow set point is approximately 100 percent of the maximum month average rated plant throughput.</u>

Filter High – This is the maximum allowable permeate flow set point. Permeate flow switches to High when the Anoxic Tank reaches the high level set point. The High Flow set point is usually equal to 200 percent of rated throughput.

Nap State – In Nap State, MBR filtration and blower are stopped. An MBR will switch to Nap State if influent flow stops or if abnormal conditions exist as described in Kubota's manual (Section 3.1.2 of the Operation Modes of the Kubota manual).

The level switches in the MBR Tanks control the system operating mode as shown in Table 9-3:

Table 9-3. Relationship Between MBR Tank Level Switches and Operating Mode

Switch	State	Control Action
LSL21302	Level Low	Generate Low Level Alarm (LAL) to HMI.
	Level Normal	MBR Tank in Filter mode.
LSH21303	Level High	Generate High Level Alarm (LAH) to HMI.
	Level Normal	Clear LAH.
LSL22302	Level Low	Generate Low Level Alarm (LAL) to HMI.
	Level Normal	MBR Tank in Filter mode.
LSH22303	Level High	Generate High Level Alarm (LAH) to HMI.
	Level Normal	Clear LAH.

Diffuser Clean – In Diffuser Clean mode filtration is suspended and air is pulsed to the MBR. This is a daily operation that starts at a user-defined time and continues for an adjustable duration (typically 3 to 5 minutes). The Diffuser Clean Valves in each MBR are opened in this mode. Section 1.4.9.1 of the Kubota Control Strategy provides a detailed description of permeate flow controls.

Alarm Nap – This happens when there are critical alarms and the MBR needs to stop permeating. The MBR operation is the same as Nap State but the MBR continues to try to go back to normal operation.

CIP Membrane Clean – In Membrane Clean mode, MBR filtration and aeration are suspended. The tank is essentially offline in anticipation of a cleaning and must be manually returned to service.

At a pre-determined time each day, the MBR diffuser cleaning valves FV21301 and FV22301 open to allow MBR-scour air to free-flow through the end of the diffuser header. The high velocity air flow causes a Venturi effect which back-washes and clears the nozzles of any accumulated debris. The automatic diffuser cleaning cycle includes the following steps:

- Stop permeate flow.
- Ensure MBR blower is running.
- Open diffuser cleaning valves and allow cleaning for duration set by operator, (typically one to three minutes).
- Close diffuser cleaning valves.
- Return to previous mode.

See Table 15 in the Kubota MBR O&M manual for more information.

9.3.2 Permeate Flow Control

Refer to Sheet P9 of the Record Drawings for a process flow depiction of the Permeate Pumps and Kubota's drawings M503 and M504 for the permeate piping plan and section.

OPERATOR'S NOTE: The permeate production system for this plant is complex, and the operator is advised to read the portion of the Kubota O&M manual that refers to the permeate control strategy.

Permeate flow control is based upon the level in the Anoxic Tanks. The Anoxic Tanks are normally connected via an open sluice gate between the tanks. The objective of the control strategy is to modulate permeate flow rate between low or medium or high flow depending on water level in the Anoxic Tanks. Control of water level should also approximately match plant influent flow. The strategy is also designed to minimize operation time at high permeate flows. The permeate flow level set points are set in the Kubota PLC program. The set points are operator adjustable.

Table 9-4 summarizes equipment tag numbers for the major equipment associated with the permeate system.

Table 9-4. Equipment Description and Tag Number for the MBR Permeate System

Equipment Description	Tag Number
MBR Permeate Pump 1	P-25001
Upstream Pressure Transmitter	PT-21305
Upstream Pressure Gauge	PG-25001A
Downstream Pressure Gauge	PG-25001B
Flow Element	FE-25103
Flow Transmitter	FIT-25103
Effluent Turbidity Analyzing Element	AE-25105
Effluent Turbidity Transmitter	AIT-25105
Effluent Nitrate Analyzer	AE-26130
MBR Permeate Pump 2	P-25002
Manual Valve	V-25002B
Upstream Pressure Gauge	PG-25002A
Downstream Pressure Gauge	PG-25002B
MBR Permeate Pump 3	P-25003
Permeate Flow Control Valve	FVC-25204
Upstream Pressure Transmitter	PT-22305
Upstream Pressure Gauge	PG-25003A
Downstream Pressure Gauge	PG-25003B
Flow Element	FE-25203
Flow Transmitter	FIT-25203
Effluent Turbidity Analyzing Element	AE-25205
Effluent Turbidity Transmitter	AIT-25205

If the MBR Tanks are in Production mode, permeate will be produced and pumped by the Permeate Pumps. Permeate flow from the MBR Tanks is continuously monitored by FIT25103 and FIT25203 for Permeate Pumps P25001 and P25003 respectively. Pump VFDs are modulated to control permeate flow at the required set point in Production mode.

Permeate flow is allowed only in Production mode (excluding the Relax cycle). If the MBR is not experiencing No Flow conditions, the Permeate Pump(s) will automatically start to increase flow as required.

Permeate turbidity is continuously monitored by AIT25105 and AIT25205. Alarms are generated when turbidity exceeds either of two operator-entered alarm limits. If permeate turbidity from a specific tank rises above operator-adjustable high level, set point, the violating MBR Tank will send a critical alarm.

When permeate flow drops below the Low Flow set point for a predefined interval, the MBR Tanks are switched to Nap State. When the calculated permeate demand increases to above the Low Flow set point, tanks are placed back into Production mode.

9.3.3 MBR Aeration Modes

Each MBR module has a bottom coarse bubble diffuser case. The coarse bubble diffusers provide continuous agitation to control the layer of MLSS that accumulates on the surface or the membranes. The coarse bubbles travel through the approximately 1/8-inch-wide space between the membrane plates. The aeration also provides oxygen for the biology that removes BOD and converts ammonia to nitrates. The optimum level of DO in this tank is between 1 and 2 mg/L but air scour is the primary objective. Each MBR Tank has a dedicated blower connected to a VFD for speed control. Operating modes and states for MBR aeration control are listed in Table 9-5.

Table 9-5. Operating Modes and States for Aeration Control

Plant Modes	Offline	Online			
MBR Tank Modes	Offline	Sleep State	Production Mode	Diffuser Clean	CIP
Aeration	Blower Off	Blower mostly off, but operates intermittently.	Blower normally running, intermittent during Nap.	Blower On	Blower Off

OPERATOR'S NOTE: Air scour blower control has low, medium and high flow rates, which are operator adjustable. The delivery rate changes are based on permeate flow rate.

9.4 Diffuser Cleaning

The diffusers are maintained using the same principle as an air-lift pump. When the diffuser cleaning valve (at top of MBR Tank) is opened, air takes the path of least resistance, bypassing the diffusers and venting to atmosphere through the open valve. The vented air draws in mixed liquor through the diffuser openings creating a pumping effect. The pumped liquor then scours the inside of the diffuser removing any biological growth and or deposits. After approximately a minute, the cleaning valve is closed and the air is forced back through the diffuser and up between the membrane plates for an additional minute before putting the system back to normal operation.

9.5 Membrane Clean-In-Place

Refer to Kubota drawing P27 for a schematic of the Kubota-supplied CIP feed system.

9.5.1 Overview

Membrane chemical cleaning (CIP) is a semi-manual operation and should be conducted regularly every 4 to 6 months according to Kubota. The operator must initiate the process and enter in the chemical cleaning solution volume from the HMI, but cleaning chemical is injected between the two membrane surfaces on each cartridge from the Mazzei clean in place system through an automated flow control valve. The operator waits for the appropriate soak time, and then drains the spent cleaning chemical from the membranes.

9.5.2 Normal Operation

Reuse water enters Kubota's chemical cleaning system from a 2-inch water line. The water passes first through a pressure regulator PCV-29001 to reduce line pressure. Water then immediately passes through flow control valve (FCV29001) which totalizes the chemical injection flow. Immediately ahead of blending with stock chlorine solution is a pressure gauge (PG29002). The 1.5-inch sodium hypochlorite solution and 2-inch reuse water pipes connect to the 2-inch Mazzei aspirating chemical injector (EDI 29002). After the injector blends the water and chlorine, the solution flows through another pressure gauge (PG29003) and a flow meter (FM29002) prior to being injected into the membranes. When the desired amount of cleaning chemical is reached, the valve should be closed. Both the flow meter and flow control valve relay can be adjusted by the operator. To perform the clean-in-place operation, follow the steps described below:

1. Calculate the required amount of chemical volume using equations found in Kubota's Operations and Maintenance manual.
2. Verify that the water level in the MBR is at least 1 foot or more above the upper membrane case.
3. Take the desired MBR offline by selecting the appropriate tank from CP-202, and manually close the permeate header isolation valves.
4. Open the chemical cleaning valves.
5. See Kubota directions.

In the case of organic cleaning, make sure the residual chlorine concentration in the permeate becomes low enough (10 mg/L or less) before restarting normal operation.

OPERATOR'S NOTE: Because the cleaning method is such that the chemical solution flows back slowly, having little pressure from the permeate side to activated sludge side, it is more effective to clean the membrane before the membrane is fully fouled, or during the period when an increase in filtration pressure is still small. This will require good recordkeeping on the part of the operators so that small deviations from normal operations are noted and addressed immediately.

9.6 Emergency Operation and Equipment Failure Workarounds

Most emergencies that arise with regard to the MBR Tanks will result in shutdown of the MBR Tank altogether. The main exception is if a dedicated MBR Tank blower fails. If available, the standby blower should be brought online to serve as the MBR blower until the out-of-service blower can be repaired or replaced. If the standby blower is not available to provide scour air, then influent to the MBR Tank should be terminated until scour air is available. If it is anticipated that the blower will be inoperable for a long period of time, the tank's contents should be drained and the tank filled with clean water so as to prevent fouling of the membrane surface.

9.7 Start-Up/Shutdown Procedures

Kubota's start-up manual provides all pertinent information regarding start-up of the MBR system; there are no specific shutdown procedures provided by the manufacturer for the MBRs. Shutdown of a membrane in essence means failure and likely replacement of the membrane in question.

Dedicated blowers for the MBRs and Aeration Tanks are turned on based on demand. Among the MBR blowers, there is a minimum 10-second delay between the start-up of each blower. Demand is a function of influent flows, DO in the Aeration Tanks, and MBR and Aeration Tanks in service. Permeate Pumps or flow control valves do not turn on or open for at least 1 minute after they are started.

9.8 Maintenance

9.8.1 Regular Operational Checks

Visual checks of the aeration pattern should be conducted daily. Additionally, WRP staff should make daily note of the following operating parameters:

- Transmembrane pressure (TMP) variability over time. Operators should keep records of average/optimal TMP so that deviations can be immediately recognized.
- Turbidity. Although the WRP is equipped with a continuous online turbidimeter, a slight deviation from historical values may be indicative of the beginnings of a problem with the membranes. Operators should be aware of historical trends in turbidity so that problems can be identified immediately.
- MBR Tank MLSS concentration.
- MLSS filterability.
- Influent screen condition and if there are any floatables in the tanks.

9.8.2 Preventative Maintenance Schedule

It is important to perform a periodic in-situ chemical cleaning of the membrane cartridges at least once every 6 months. Periodic diffuser cleaning using a cleaning valve is currently set to automatic operation. Refer to the detailed method for both of these cleanings in Kubota's O&M manual.

OPERATOR'S NOTE: Never perform a chemical clean by injection with a pump. The system is designed to be gravity injected in order to prevent a pressure increase in, and possible damage to, the membranes.

SAFETY NOTE! Oxalic acid and highly concentrated sodium hypochlorite used to clean the membranes are potentially hazardous, particularly if the two come into contact with each other. Operators should consult the Safety Data Sheets (SDS) and take all proper health and safety precautions prior to and during membrane cleaning.

The manufacturer also recommends an inspection every 3 years during which the retaining rubber and permeate tubing are replaced. Operators should also regularly inspect and maintain the following items:

- Suction pressure fluctuations.
- Diffuser inspection, and cleaning if needed.
- Equipment maintenance per the manufacturer’s manuals.
- Inspection of screens and wells.

10. FEED FORWARD PUMPS

This chapter describes the operation of the Feed Forward (FF) Pumps in conjunction with the MBR process. The general concept of the Feed Forward Pumps is to provide internal recycling of mixed liquor flow for the MBR system, by pumping mixed liquor from the Anoxic Tank to the Aeration Tank. Refer to Sheets P5, M305, and M307 in the Record Drawings for a depiction of the process flow and piping related to the Feed Forward Pumps. See Appendix D, Figure D-5 for the Feed Forward SCADA screen.

10.1 Overview

Denitrification in the WRP is achieved by recycling nitrified mixed liquor back to the Anoxic Tanks through the MLR channel. MLR flow is a hydraulic loop inside the WRP process, usually flowing at rates six times the influent flow to achieve adequate nitrogen removal. The MLR flows over a fixed weir plate at the MBR Tank and into the MLR channel. Influent Pump flow also enters the channel, downstream of the MBR Tanks. The Influent Pump flow mixes with the MLR flow on its way to the Anoxic Tank influent weirs. A dedicated Feed Forward Pump then pumps Anoxic Tank mixed liquor to its downstream Aeration Tank. There are three Feed Forward Pumps (two duty, one standby); each Feed Forward Pump has an associated flow meter, and the Kubota control system controls the speed of the pumps.

Because the MLR flowing back to the Anoxic Tanks creates a hydraulic loop in the WRP process, any change in feed forward flow changes the MLR flow rate back to the Anoxic Tanks. Consequently, large surges of mixed liquor out of the MBR Tanks will flow into the Anoxic Tanks, resulting in undesirable fluctuations in tank level.

OPERATOR'S NOTE: Turning the blowers on in the MBR Tanks results in a large displacement of liquid tank volume, raises the level of the MBR Tanks, and spills into the mixed liquor channel. Because the WRP will operate in Sleep or Nap mode for substantial portions of time, operators should monitor the Anoxic Tank level.

Table 10-1 on the following page provides equipment tag numbers for the Feed Forward Pumps and associated equipment.

Table 10-1. Equipment Description and Tag Numbers for Feed Forward Pumps

Equipment Description	Tag Number
Feed Forward Pump 1	P-21111
Temperature Switch High	TSH-21111
Moisture Switch High	MSH-21111
Feed Forward Pump 2	P-21112
Temperature Switch High	TSH-21112
Moisture Switch High	MSH-21112
Feed Forward Pump 3	P-21113
Temperature Switch High	TSH-21113
Moisture Switch High	MSH-21113

(Table Continues)

Table 10-1. Equipment Description and Tag Numbers for Feed Forward Pumps (Continued)

Equipment Description	Tag Number
Feed Forward Pumps	
Type	Vertical Non-Clog Dry Pit Centrifugal
Number (one standby)	3 (2 Duty, 1 Standby)
Flow Rate (gpm)	475 at 28 feet total dynamic head (TDH)
Motor	7.5 hp, 460 V, 3-Phase, 60 Hz
Percent Solids Pumping Capacity (%)	1.0

10.2 Normal Operation and Control

The normal operation of the Feed Forward Pumps is flow control based on the flow selected by the operator at the Kubota control panel. The design value used for the internal recycle rate is (6Q [Q = the maximum month average influent flow]). Adding the recycle flow to influent flow equals 7Q. Therefore, if the facility high flows are around 195,000 gpd, this equates to 474 gpm for each of the 2 FF Pumps. Once the set point is made in the control system, the pump speed will modulate as needed to meet this FF flow set point.

10.2.1 Automatic Operation of the Feed Forward Pumps

To place the Feed Forward Pumps in Automatic:

1. Place the HOA switches on MCC 201 and MCC 202 in Automatic.
2. Select MLR pumping from the HMI and place each pump in Automatic by tapping the screen at each pump and selecting Automatic.

10.2.2 SCADA Manual Control of the Feed Forward Pumps

From the HMI, select the Feed Forward Pumps to operate in Manual. From the HMI, select MBR System and select the Feed Forward Pump to operate in Manual. Set desired pump speed.

10.2.3 Equipment Failure Workarounds

If one Feed Forward Pump fails, the standby pump can be manually switched over and put into operation. In the unlikely event that two pumps fail, all flow can be pumped via one Feed Forward Pump from one Anoxic Tank. The operator would need to manually make the pump valve and tank gate changes. In the very unlikely situation that all three Feed Forward Pumps fail, the future Anoxic Tanks could be used for temporary flow storage. The influent gates to Anoxic Tanks 3 and/or 4 could be opened, while gates to Tanks 1 and 2 would be closed. This operation would allow time to get the Feed Forward Pumps operating again. This would require very careful monitoring of the level in the Anoxic Tanks. Placing a portable pump in the Anoxic Tank to temporarily pump mixed liquor to the Aeration Tank is another option for failure of all pumps.

11. SOLIDS STORAGE TANK

This chapter describes the operation of the Solids Storage Tank, Solids Tank blower, Waste Activated Sludge (WAS) Pumps, Solids Tank decant process, and WAS Loading Pump in conjunction with the MBR Tanks. Refer to Sheet P14 of the Record Drawings for the process flow diagram and Sheets M301 and M302 for the mechanical drawings of the pumps. The terms “Solids Tank” and “Solids Storage Tank” are used interchangeably in this manual.

The general concept of the system is that WAS is transferred from the MLR channel with WAS Pumps to the Solids Tank for storage and thickening. Mixing and partial aerobic digestion is accomplished in the Solids Tank through periodic use of the Solids Tank blower. Additionally, WAS can be thickened in the Solids Tank through a decanting process. Thickened WAS is transferred into trucks for hauling off-site using WAS Loading Pumps (different from the WAS Pumps).

11.1 Overview

The WAS Pumps are horizontal dry pit pumps located at the south end of the utilidor. There are two WAS Pumps, one duty and one standby. The pumps normally pull solids from the MLR channel, just upstream of where the SDS influent wastewater enters the channel, and pumps the solids through a 3-inch pipe to the Solids Tank. The operator can also choose to draw solids out of the Aeration Tank discharge channel with these pumps. Manual valve changes would be required for this operation.

Pumping WAS flow to the Solids Tank is automatically controlled based on operator defined WAS Pump flow and run-time set points. Operator experience and judgment will need to be used to determine the appropriate wastage rates depending on influent flows and sludge characteristics of MBR Tanks.

The Solids Tank is aerated with a bank of stainless steel coarse bubble diffusers designed to keep the sludge mixed and prevent it from going septic.

To increase the pounds of solids storage capacity, the operator can thicken the solids by performing a decanting operation using the telescoping valve to draw decant water off the top of the tank after solids are settled. Because the telescoping valve can only decant the top 4 feet of the Solids Tank, the tank water level would need to be within 2 feet of the top water level. This operation would consist of turning the aeration system off for 30 to 90 minutes to allow solids to settle in the Solids Tank. Once there is a clear water layer, the telescoping valve is manually lowered and the clear top layer is drained to the Anoxic Tank. The telescoping valve has a bonnet to prevent foam from being transferred to the Anoxic Tank.

There is currently one WAS Loading Pump, with space for one additional future WAS Loading Pump. The WAS Loading Pumps are used to periodically pump thickened sludge from the Solids Tank to the sludge loading station where trucks can connect flexible hoses and load the sludge. The connection is a horizontal 3-inch pipe with a 3-inch Camlock adapter that accommodates sludge hoses. Thickened WAS is loaded into trucks and hauled off-site for treatment and processing. The load-out point is located at the northeast corner of MBR Train 1. The station is equipped with a local control panel that can start and stop the WAS Loading Pump as needed during sludge truck loading. The operator will need to start and stop the pump from this panel (not remotely).

Table 11-1 provides equipment tag numbers associated with the WAS loading and storage equipment.

Table 11-1. Equipment Description and Tag Numbers for Solids Tank and WAS Pumps

Equipment Description	Tag Number
Solids Tank/Blower	B-27804
Pressure Indicator	PI-27804
Temperature Indicator	TI-27804
Temperature Sensor High	TSH-27804A
Solids Tank/Level Sensor	
Level Sensor	LE-27803
Level Transmitter	LT-27803
Solids Tank/Level Switches	
Level Float High	LSH-27805
Level Float Low	LSLL-27805
WAS Pump 1	P-27801
Temperature Switch High	TSH-27801
WAS Pump 2	P-27802
Temperature Switch High	TSH-27802
WAS Flow Meter	
Flow Element	FE-21401
Flow Transmitter	FT-21401
WAS Loading Pump 1	P-27807
Temperature Switch	TS-27807
Moisture Element	ME-27807
WAS Loading Pump 2 (Future)	P-27806
Temperature Switch	TS-27806
Moisture Element	ME-27806
WAS Loading Control Panel	CP-278

11.2 Design Criteria

Table 11-2 outlines design criteria for equipment associated with the WAS loading and storage equipment.

Table 11-2. Design Criteria for Solids Handling Equipment

Solids Tank	
Length (feet)	24
Width (feet)	14.5
Depth (feet)	17
Side Water Depth (feet)	15
Operational Volume (gallon)	Approx. 39,000 (5,220 cubic feet)
Solids Tank Blower	
Number	1
Capacity (scfm)	160
Operating Pressure (psig)	7.5
Motor (horsepower)	10
WAS Pumps	
Type	Horizontal In-Line
Number (installed)	2
Flow Rate (gpm)	150 at 20 feet TDH
Motor	2 HP, 460 V, 3-Phase, 60 Hz
WAS Loading Pump	
Type	Submersible
Number (installed)	1 (1 Duty)
Flow Rate (gpm)	200 at 25 feet TDH
Motor	5 hp 460 V, 3-phase, 60 Hz

11.3 Normal Operation and Control

11.3.1 Automatic Control of the WAS Pumps

The Solids Tank is equipped with a level sensor and level switches to alarm if the tank exceeds the high water level or low water level set points. For automatic control:

- Determine desired daily WAS flow to the Solids Tank. This will largely be based on operator judgment, influent flows to the WRP, sludge characteristics, etc.
- From the HMI, select Process Settings and select WAS Pumps.
- Set the desired WAS flow.
- From the HMI, select Process Settings and select Solids Tank. Set the desired minimum tank level.

OPERATOR'S NOTE: The Solids Tank aeration system should be turned off for 30 to 90 minutes before solids are pumped from the tank. The operators need to ensure that MLSS levels in the MBR tanks do not drop excessively because of over wasting.

11.4 Emergency Operation and Control

11.4.1 Equipment Failure Workarounds

11.4.1.1 Solids Tank

If the Solids Tank blower fails, it is not an emergency condition. Ideally, the blower should be put back into operation in less than 24 hours. If the delay is longer than this, the main concern is that anaerobic conditions would develop. The Aeration Tank 1 blower pipe is connected to the Solids Tank air pipe and can be used as a temporary method of providing air to the Solids Tank. The operator would have to manually open the valve on the connecting pipe. The MBR system has a standby blower that could also be connected to the Solids Tank with a temporary pipe.

11.4.1.2 Solids Loading Pumps

There is only one loading pump currently installed to provide WAS loading service. In the event that the pump is out of service, the sludge tanker truck would need to pull WAS directly out of the Solids Tank using the tanker truck's pump.

12. DISINFECTION

This section provides Operations and Maintenance information for the ultraviolet and sodium hypochlorite (chlorine) disinfection system. See Appendix D, Figures D-11, D-13, and D-14 for control screens related to the disinfection processes.

12.1 Overview

The Cowlitz WRP has a dual disinfection system that includes both ultraviolet (UV) treatment and chlorine treatment. The facility has been designed and constructed with two disinfection systems to ensure that the reclaimed water produced by the WRP meets or exceeds Class A reclaimed water standards at all times. Refer to Sheets M308, M310, M311, and P10 of the Record Drawings for details and schematic depictions of the UV disinfection system. Refer to Drawings P15 and M314 for details and schematic depictions of the chlorine storage and pump equipment. Chlorine injection locations within the facility are schematically depicted on Sheets M308, M316, P10, and P12.

12.1.1 Ultraviolet Disinfection System

The WRP has two medium pressure, high intensity, closed vessel UV reactors that disinfect the MBR effluent prior to being piped to the Reclaimed Water Tank. The UV modules are located downstream of the Permeate Pumps. Disinfecting the wastewater through the UV modules is an essential step in ensuring the final facility effluent meets or exceeds Class A reclaimed water standards.

OPERATOR'S NOTE: The UV banks have a start-up and cool-down delay program. The lamps take a few minutes to warm up and reach full potency. The lamps also need a cool-down time to adequately disperse heat. These delays are included in the UV system programming.

The UV lamps are rated to provide approximately 1 year of continuous use. The operators will need to check run time hours and replace the bulbs when the manufacturer's recommended replacement time is reached, or if the SCADA system indicates low intensity.

SAFETY NOTE! UV light is hazardous to skin and eyes. Operators should never open a closed UV vessel when the UV lamps are on. Disconnect power with proper lockout/tagout procedures prior to servicing the UV lamps.

Table 12-1 on the following page summarizes equipment associated with the UV disinfection system.

Table 12-1. Equipment Description and Tag Number for UV Disinfection Equipment

Equipment Description	Tag Number
UV Bank 2A	UV-26112
UV Bank 2B	UV-26113
UV Bank 2 Control Panel	CP-204B
Control Valve Bank 2	CV-26112
Isolation Valve Bank 2	V-26113A
Recirculation Pump Bank 2	P-26114
UV Bank 1A (Future)	UV-26102
UV Bank 1B (Future)	UV-26103
UV Bank 1 Control Panel (Future)	CP-204A
Control Valve Bank 1	CV-26102
Isolation Valve Bank 1	V-26103A

12.1.2 Chlorine System

In addition to UV disinfection, the Cowlitz WRP doses the reclaimed water with chlorine as an additional disinfection agent prior to use as plant reuse water or discharging reclaimed water to the well injection site. Sodium hypochlorite solution (12.5 percent concentration) is brought on-site and stored in drums which are housed in the Chemical Feed Room. Also housed in the Chemical Feed Room are the Chlorine Solution (CLS) Feed Pumps and the chlorine day tank (Table 12-2). Chlorine solution is injected directly into facility pipes at two separate locations in the reclaimed water piping system. One injection location is downstream of the UV disinfection system prior to the Reclaimed Water Tank, and the other location is in the reclaimed water line to the injection wells downstream of the injection pumps. Normally only the injection point upstream of the Reclaimed Water Tank is used.

Table 12-2. Equipment Description and Tag Number for Chlorine Disinfection Equipment

Equipment Description	Tag Number
Chlorine Solution Drum Pump	P-29010
Chlorine Solution Day Tank	T-29011
Chlorine Solution Feed Pump 1	P-29021
Chlorine Solution Feed Pump 2	P-29022
Chlorine Solution Feed Pump 3	P-29023

12.2 Design Criteria

12.2.1 Ultraviolet Disinfection

Table 12-3 summarizes design criteria for the UV disinfection system at the WRP.

Table 12-3. Design Criteria for the UV Disinfection Equipment

UV Disinfection	
Medium Pressure Closed Vessel	
Trains (number)	1 (current), 2 (future)
UV Banks Per Train	2
UV Transmittance (percentage)	65
Peak Flow Per Train (mgd)	0.56
Maximum 30-day Average Flow Per Train (mgd)	0.2
UV Dose (millijoule per cubic centimeter [mJ/cm^3] maximum flow)	80
Effluent Total Coliform Maximum (most probable number [MPN] per 100 mL)	2.2

The UV system was designed with one treatment train consisting of two UV chambers to handle current flowrates. To accommodate for future hydraulic loading rates, a second set of UV chambers may be installed to increase the capacity of the system (UV-26102 and UV-26103). Mechanical piping was designed for easy installation of future UV chambers.

Each UV chamber houses four, type B2020H, inline lamps. Each lamp is protected from contact with the process water by a high purity quartz sleeve. Should lamps need to be removed for inspection, they can be removed from either end of the chamber without needing to first drain the chamber. One lamp in each of the chambers is outfitted with a UV monitor which measures the UV intensity emitted from the lamp. Sensors in the monitoring system only measure the germicidal portion of the light emitted by the UV lamps in wavelengths between 220 nanometers (nm) and 290 nm. The readout generated by the monitor can be used by the operators for performance verification purposes.

If the lamps are turned off and on more than a few times per day, it reduces the lamp life. The UV system is fitted with a recirculation pump system so that the lamps are not over cycled and helps prevent the system from overheating during no-, or low-flow conditions. The recirculation pump system is designed to operate when the permeate flow has stopped. Additionally, the UV chambers are fitted with a temperature sensor to protect against heat buildup. In the event of a heat buildup, the UV system will shut down and an alarm will be activated.

12.2.2 Chlorine

Table 12-4 summarizes design criteria for the chlorine system at the Cowlitz WRP.

Table 12-4. Design Criteria for the Chlorine Disinfection Equipment

Sodium Hypochlorite Solution Concentration	12.5%
CLS Feed Pumps:	
Number of Pumps	3
Type of Pumps	Diaphragm-Type
Maximum Discharge Pressure	40 psi
Minimum Discharge Pressure	25 psi
Maximum Flow	2.1 gallons per hour (gph)
CLS Drum Pump:	
Type of Pump	Immersed centrifugal-type
Number of Pumps	1
Minimum Flow	10 gpm
Head	8 feet

The chlorine system is designed to disinfect reclaimed water at the WRP and to make sure reclaimed water stays disinfected until it is used as on-site reuse water or enters the vadose zone through the injection wells. The system also serves as a back-up to the UV system. The system is designed to provide a residual of 0.5 mg/L of chlorine at the vadose zone wells. It is important that an active chlorine residual concentration be maintained through the point where reclaimed water is injected into the vadose zone. To make certain that residual is maintained along the entire length of discharge pipe, chlorine is injected into the effluent reclaimed water pipe at two locations:

- Downstream of the UV disinfection system before entering the Reclaimed Water Tank.
- Downstream of the Well Injection Pumps before reclaimed water leaves the WRP.

The first injection point is located on the southwest wall of the Mechanical Room, where chlorine is injected through a 3/8-inch pipe into the side of the 8-inch reclaimed water pipe. After injection, reclaimed water is piped to the Reclaimed Water Tank where it is stored and the chlorine is given time to disinfect. Storage time in the Reclaimed Water Tank varies depending on the hydraulic loading rate for the overall facility. For additional information regarding the Reclaimed Water Tank see Section 13.1.

The second injection point is located downstream of the Well Injection Pumps along the west wall of the Well Injection Pump room, where chlorine is injected through a 3/8-inch pipe into the 8-inch reclaimed water pipe. The purpose of the second injection point is to restore any free chlorine residual that may have been lost after reacting with organic compounds in the Reclaimed Water Tank if needed. A chlorine analyzer is located directly upstream of the second injection point to measure the residual chlorine concentration in the reclaimed water after it has left the Reclaimed Water Tank.

Chlorine is pumped to the injection locations through three feed pumps located in the Chemical Room. Feed Pump 1 supplies chlorine solution to the first injection point in the Mechanical Room and Feed Pump 3 supplies chlorine solution to the second injection point in the Well Injection Pump Room. Feed Pump 2 is designated as a standby pump and can pump chlorine solution to either injection point depending on the operating position of the valves downstream of the pumps. The pumps draw sodium hypochlorite solution from a 35-gallon day tank which in turn is filled by an adjacent drum pump mounted to a 55-gallon drum. Floats in the day tank control the on-off operation of the drum pump. PVC pipe connects the day tank and drum to an outside vent to prevent chlorine gas from building up in the Chemical Room.

12.3 Normal Operation

12.3.1 Ultraviolet

During normal operation, the lamps should be set to run continuously. The operator should regularly sample the process water to ensure that one bank is providing adequate/anticipated treatment. The operator should sample the process water when flows exceed 0.5 mgd (350 gpm) to ensure that the UV system is providing disinfection as designed during high flow events. When flows are less than 135 gpm, the operator may wish to operate with only one UV bank on to conserve electrical power.

Each UV chamber is fitted with an automatic, mechanical cleaning mechanism that consists of a stainless steel yoke and Teflon bosses. Each boss holds one wiper ring that fits over the quartz sleeve and runs the length of the UV bulb during cleaning cycles. The frequency of the cleaning cycles is to be determined by the operators. Too little cleaning may cause fouling on the lamp sleeves. Too much cleaning will cause excessive wear on the cleaning mechanism. Cleaning cycles can be adjusted by the operators through the control system or manually adjusted through the operator interface.

The power/control module for the UV system is located in the Mechanical Room. The operator can interface with the system through an eye level Human Machine Interface (HMI) screen. Using the HMI, the operator can adjust the power level of the UV lamps, view run hours for each lamp, control cleaning cycles, and manually turn lamps on or off.

The UV system is not designed to provide redundancy in the disinfection system. Redundancy is provided through the chlorine system. Should flowrates exceed the capacity of the single UV disinfection train, (flowrates exceeding 0.56 mgd) the chlorine system (as described in this chapter) will provide any additional disinfection that may be needed. Should flowrates begin to consistently exceed the hydraulic capacity of the single UV train, the Tribe should install the second UV train.

To simplify the routine inspection process, each UV chamber is fitted with an access hatch that can be used by operators to visually inspect the lamp sleeve and/or remove debris from the chamber without removing the lamps or quartz sleeves. If lamps need to be removed for further inspection, they can be extracted from either end of the lamp chamber.

SAFETY NOTE! UV light is hazardous to skin and eyes. The operators should never open a closed UV vessel when the UV lamps are on.

12.3.2 Chlorine Disinfection

In Automatic mode, Chlorine Feed Pump 1 will run whenever there is permeate flow, and will modulate with flow rate to avoid over or under dosing. If the chlorine analyzer downstream of the Well Injection Pumps indicates that chlorine residual is not being maintained in the Reclaimed Water Tank, Chlorine Feed Pump 3 will run, and can modulate based on the chlorine residual concentration in the reclaimed water and the reclaimed water flow rate. Operators have the flexibility to manually operate the feed pumps should conditions warrant.

It is essential for operators to keep inventory on the chlorine drums and the quantity of chlorine in the drums. At all times there should be backup drums full of chlorine solution available on-site. All reclaimed water discharged by the facility shall receive chlorine disinfection treatment. It is unacceptable for the chlorine disinfection system to stop operating simply because the facility has expended all of the on-site chlorine solution. When moving the drum pump to a different drum, first make sure that the volume of chlorine solution in the day tank is sufficient to supply the system with solution for the duration of the operation.

SAFETY NOTE! Highly concentrated chlorine solution can potentially cause bodily harm through physical contact. The operators should always take appropriate precautionary measures when handling the solution. Always handle the solution in ventilated areas.

12.4 Emergency Operation and Equipment Workarounds

In the event that the drum pump fails:

- Do not let the chlorine solution level in the day tank drop below the low level point. Manually fill the day tank using a hand pump or other pump suitable for chlorine contact, keeping the solution level above the preset low level point in the tank until the drum pump can be repaired or replaced.

In the event that one of the feed pumps is out of service or down for maintenance:

- Operate Feed Pump 2 in its place until the designated feed pump is back online. When switching operational functions to Feed Pump 2, make sure Feed Pump 2 is pumping chlorine solution to the desired injection point prior to shutting down Feed Pump 1 or 3 for maintenance. Do this to avoid a lapse in injection.

In the event that the UV chamber or one train is out of service or down for maintenance:

- The operator should rely on the chlorine disinfection system until the UV system is once again functional. If the UV chambers become non-functional, operators should work on getting the UV chambers working again as quickly as possible. Vadose zone injection of wastewater that is not disinfected could potentially impact groundwater and drinking water sources. During a UV outage, the operators should pay close attention to the chlorine residual concentrations as measured by the chlorine sampler to make sure that the desired residual concentration is maintained past the second chlorine injection point. Operators may need to increase chlorine dosage under these circumstances and/or increase the reclaimed water's hydraulic retention time in the Reclaimed Water Tank to provide a longer initial contact time.

In the event that the permeate flow rate exceeds the design maximum flow rate for the single train of UV chambers:

- The operators should pay close attention to the chlorine residual concentrations as measured by the chlorine sampler to make sure that the desired residual concentration is maintained past the second chlorine injection point. Operators may need to increase chlorine dosage under these circumstances and/or increase the reclaimed water's hydraulic retention time in the Reclaimed Water Tank to provide a longer initial contact time. Should the single train of UV chambers become hydraulically overloaded on a consistent basis, install the second set of UV chambers.

In the event that the first chlorine injection point becomes non-functional (either due to feed pump failure or other mechanical problems):

- The operator should consider conducting one or both of the following procedures until chlorine solution can once again be injected at the Mechanical Room injection point:
  - Manually dose chlorine solution directly into the Reclaimed Water Tank through the tank hatches. Make sure chlorine is dosed after every fill draw cycle.
  - Increase chlorine dose at the second injection point.
  - Store reclaimed water in the Reclaimed Water Tank until the injection point is once again operational.
- Regardless of which procedure is implemented, operators shall manually gather reclaimed water samples at the furthest injection well in operation to test for chlorine residual.

In the event that the second Chlorine injection point becomes non-functional (either due to feed pump failure or other mechanical problems):

- The operator should consider conducting one or both of the following procedures until chlorine solution can once again be injected at the Well Injection Pump Room injection point:
  - Increase chlorine dose at the first injection point and monitor the residual concentration at the chlorine sampler.
  - Store reclaimed water in the Reclaimed Water Tank until the injection point is once again operational.
- Regardless of which procedure is implemented, operators shall manually gather reclaimed water samples at the furthest injection well in operation to test for chlorine residual.

In the event that the chlorine disinfection system fails or a combination of the UV disinfection system and the chlorine disinfection system simultaneously fail:

- The operator should turn off the Well Injection Pumps and facility Reuse Water Pumps until at least the chlorine system is back online. While the Well Injection Pumps are off, store reclaimed water in the Reclaimed Water Tank. Should the Reclaimed Water Tank become full before the disinfection system is back online, store influent wastewater in the unequipped treatment trains as outlined in Chapter 7. Depending on how long the reclaimed water is stored in the Reclaimed Water Tank and the residual concentration in the tank, the operator may need to manually dose chlorine into the reclaimed water in the tank.

13. RECLAIMED WATER STORAGE TANK AND WELL INJECTION PUMPS

This chapter discusses storage, equalization, and well injection pumping for reclaimed water produced by the WRP.

Screened sewage equalization storage for the WRP is currently provided in the unequipped Anoxic and Aeration Tanks in Trains 3 and 4 as discussed in Chapter 7.

13.1 Reclaimed Water Tank

13.1.1 Overview

The Reclaimed Water Tank is an above-ground concrete reservoir located east of the process tanks. The tank provides storage for the WRP reuse water system described in Chapter 15, as well as storage and equalization for the Well Injection Pumps and Vadose Zone Injection Wells. Reclaimed water storage is essential to ensure that the well injection pumping system can almost continuously supply the appropriate steady amount of reclaimed water to the Vadose Zone Well system. Injection of reclaimed water to the injection wells should be as steady and continuous as possible throughout the day. Under high flow conditions or during diurnal variations, when reclaimed water production exceeds the desired infiltration rate at the injection well(s), water levels in the Reclaimed Water Tank will be allowed to rise, helping equalize the flow and maintain the desired steady well injection rate. During low flow conditions, the infiltration capacity of the injection well(s) will be greater than reclaimed water production. The control system will then allow the water level in the Reclaimed Water Tank to drop.

13.1.2 Design Criteria

Table 13-1 summarizes the design criteria for the Reclaimed Water Tank.

Table 13-1. Design Criteria for Reclaimed Water Tank

Reclaimed Water Tank	
Diameter (feet)	30
Depth (feet)	30
Normal EQ Operational Side Water Depth (feet)	10
Maximum EQ Storage Side Water Depth, overflow (feet)	29.5
EQ Storage Volume (gallon)	150,000

As depicted in Table 13-1, a total of 150,000 gallons of reclaimed water storage are available. At two-train design flows, when both trains are in operation, this equates to approximately 18.5 hours of flow storage at Maximum Month Design Flow (0.195 mgd) and 12 hours of flow storage at Peak Day Design Flow (0.3 mgd), if all flow is stored in the Reclaimed Water Tank. At four-train design flows, this equates to approximately 9.2 hours of flow storage at Maximum Month Design Flow, and 6 hours of flow storage at Peak Day Design Flow, if all flow is stored in the Reclaimed Water Tank. The Well Injection Pumps shut off if the depth in the tank drops to 3.5 feet.

13.1.3 Normal Operation and Control

The Reclaimed Water Tank is used to supply the WRP reuse water system and equalize flows being pumped to the injection wells, and to provide the system with operational flexibility. As long as the water levels in the tank remain at or above the low operating level (18 inches), the Reuse Water Pump can draw reclaimed water from the tank. Reclaimed water not used by the reuse water system is pumped by the Well Injection Pumps, described in Section 13.2, to the Vadose Zone Injection Wells. Redundant level transducers in the tank measure water levels for the pump control system and trigger alarms if the tank levels reach the operator adjustable Low or High level set points. A further redundant system of float switches will trigger Low, Low-Low, or High-High Water alarms if the level transducers fail. The Reclaimed Water Tank also includes a gravity overflow at a side water depth of 29.5 feet. Filling and emptying of the tank is accomplished as described in the following sections.

Operators will need to anticipate higher weekend, holiday, and/or special event flow rates and ensure that the Well Injection Pumps are on at the right time to prevent the reservoir from reaching top water level, especially during periods when the WRP may be unmanned. This will prevent unnecessary use of the backup Vadose Zone Injection Well.

13.1.4 Filling

Under normal operation, the Permeate Pumps will pump water to the Reclaimed Water Tank whenever the MBR system is permeating. Flow from the Permeate Pumps travels through the UV disinfection and then is dosed with sodium hypochlorite (CLS) in the Mechanical Room prior to entering the Reclaimed Water Tank through a tideflex check valve located approximately 12 feet above the floor of the tank. During normal operating conditions, water levels in the tank should vary between 5 and 20 feet. Under peak flow conditions, flow from the Permeate Pumps will be partially held to equalize flow, and water level in the reclaimed water tank will rise. If water levels in the tank reach the maximum normal operating level with the lead well open at maximum flow, a signal will be sent via radio transmission to the backup well to open its control valve and begin infiltrating reclaimed water. After peak flow conditions have subsided, Well Injection Pumps will draw down the water level in the tank to normal operating levels, and a signal will be sent to the backup well to close its control valve.

For tank maintenance, follow the procedure described below in Section 13.1.6.

13.1.5 Draining

Under normal operation, draining of the Reclaimed Water Tank will be accomplished by both the Reuse Water Pumps and the Well Injection Pumps. A VSmart control valve located at the bottom of the lead vadose zone injection well will discharge water at the rate designated by the well injection control. Control of the Well Injection Pumps is based on maintaining a designated pressure in the pipe going to the injection wells. Because the tank has reclaimed water in it, any water that can’t be extracted by the reuse system should be pumped back to the MBR treatment facility using a portable pump on the 4-inch drain line.

OPERATOR’S NOTE: The Permeate Pumps and Well Injection Pumps should not be operated with the Reclaimed Water Tank offline. Maintenance of the Reclaimed Water Tank should be scheduled at low flow periods, with provisions for influent equalization in place. Maintenance operations should be scheduled to minimize down time.

13.1.6 Emergency Operation

If the tank side water level rises to the top level set point, the high level alarm will activate, notifying operators that the tank may exceed its storage capacity. There is also a float switch (High-High) that provides a backup alarm. Above the High-High float switch, an 8-inch gravity overflow pipe is located approximately 6 inches below the roof of the tank. This overflow will route excess flow to an adjacent drainage ditch. While the gravity overflow drain functions passively without the need for manual valve operation, operators should visually confirm that the drain outlet is functioning properly during an overflow scenario. Overflow is a last resort because the tank contains reclaimed water and is not permitted for surface discharge.

If necessary, the 4-inch drain may be connected to a pump and pumped to the MBR process tanks. Note that this drain pipe inlet extends 6 inches above the tank bottom so the tank cannot be completely drained with this pipe.

Should flow need to be bypassed around the water reuse tank, follow the procedure below, referencing Sheet C10 of the Record Drawings:

- Close the gate valve on the tank side of the 8-inch tee on the reclaimed water inlet line coming from the WRP (located at N 195945.29, E 1079417.32 as shown on Sheet C10). This will prevent flow from entering the tank.
- Close the 8-inch gate valve adjacent to the tank on the reclaimed water outlet line leading to the Well Injection Pumps.
- Open the 8-inch gate valve located along the bypass pipe at the tee (located at N 195034.53, E 1079428.06 as shown on Sheet C10).

Following this procedure will route reclaimed water from the Permeate Pumps directly to the Well Injection Pumps.

OPERATOR'S NOTE: Permeate Pumps are positive displacement pumps. Care should be taken to protect the downstream systems from over pressure if the Reclaimed Water Tank valves are closed.

13.1.7 Maintenance

While there is limited equipment associated with the Reclaimed Water Tank, proper maintenance is critical to ensure proper operation. The influent duckbill check valve should be checked every 5 years to ensure it is clean and unobstructed. Gate valves associated with the Reclaimed Water Tank should be regularly exercised. The tank should be inspected every 5 years, and drained and thoroughly cleaned if inspection indicates significant sediment accumulation. The 4-inch drain pipe and 8-inch gravity overflow pipe should be checked to ensure they are free of obstructions during the inspection operation.

OPERATOR'S NOTE: The Permeate Pumps and Well Injection Pumps should not be operated with the Reclaimed Water Tank offline. Maintenance of the Reclaimed Water Tank should be scheduled at low flow periods, with provisions for influent equalization in place. Maintenance operations should be scheduled to minimize down time.

13.2 Well Injection Pumps

13.2.1 Overview

The Well Injection Pump system consists of four skid-mounted pumps. These pumps operate in a lead/lag1/lag2/standby fashion. The pumps function to supply reclaimed water to the injection wells at a constant pressure for 45 to 140 gpm flow. The rated flow rate of each pump is 185 gallons per minute. The pumps operate at variable speeds on VFDs to maintain a constant supply pressure to the injection wells.

The Well Injection Pump system is detailed in the Record Drawings on Sheets P12 and M316.

Table 13-2 provides the equipment tag numbers for the pumps and major pieces of equipment.

Table 13-2. Equipment and Equipment Tags for Well Injection Pump Skid

Equipment Description	Tag Number
Well Injection Pump Skid Pressure Transmitter	PT-26530
Well Injection Pump Skid Flow Meter	FE/FT-26540
Well Injection Pump 1	P-26531
Injection Pump 1 Temperature Switch	TSH-26531
Well Injection Pump 2	P-26532
Injection Pump 2 Temperature Switch	TSH-26532
Well Injection Pump 3	P-26533
Injection Pump 3 Temperature Switch	TSH-26533
Well Injection Pump 4	P-26534
Injection Pump 4 Temperature Switch	TSH-26534
Injection Pump Skid Hydropneumatic Tank 1	T-26535
Injection Pump Skid Hydropneumatic Tank 2	T-26536

Each Well Injection Pump includes its own isolation valves, check valve, and VFD.

13.2.2 Design Criteria

Table 13-3 summarizes the design criteria for the Well Injection Pumps.

Table 13-3. Design Criteria for Well Injection Pump System Equipment

Well Injection Pumps Performance Requirements	
Pumping Condition A – Rated Capacity at Full Speed	
Capacity (gpm, each pump)	185
Total Head (feet)	70
Minimum Hydraulic Efficiency (percent)	58
Approximate Pump Speed (rpm)	3,300
Pumping Condition B – Run Out at Full Speed	
Capacity (gpm, each pump)	200
Total Head (feet)	53
Minimum Hydraulic Efficiency (percent)	40
Pumping Condition C – High Head at Full Speed	
Capacity (gpm, each pump)	100
Total Head (feet)	126
Minimum Hydraulic Efficiency (percent)	55
Pumping Condition D – Reduced Speed	
Capacity (gpm, each pump)	50
Total Head (psi)	30

13.2.3 Normal Operation and Control

13.2.3.1 Continuous Pressure Control Mode

See Appendix D, Figures D-15 and D-16.

With the HAND-OFF-AUTO switch on the VFD operator interface placed in the AUTO position, the three lead/lag pumps will be controlled automatically by CP-201 based on the Injection Well Supply pressure via the PLC. The controls will maintain a constant supply pressure (operator adjustable set point) to the hydropneumatic tanks and the Injection Wells. When the pumps are first engaged, the pumps will start at slow speed determined by the PID controller. The pumps will operate in Continuous Pressure Control mode provided all the following permissives are true:

1. At least one injection well is open.
2. There is no failure in the control system.
3. The Reclaimed Water Tank level is above the Low-Low Alarm.

Due to low flow demand during the initial year of operation, it is expected that typically one pump will be utilized at any given time. To ensure equal use of pumps, the lead pump will alternate on a schedule as determined by the operator (see Chapter 16). The operator may also choose to select the lead pump manually.

13.2.3.2 Fluctuating Reclaimed Water Tank Level

When the water level decreases and proceeds to fall below the Low-Low Alarm, the VSmart valves will close, then the well injection pumps will turn off. The pump will come on again if pressure in the well main drops below the set point. Two hydropneumatic tanks will also provide limited backup volume to maintain system pressures at the injection wells if the Well Injection Pump does not immediately restart due to pressure loss. The operator, via the Well Injection Pump controls, determines when a pump is turned on after the Reclaimed Water Tank water level is above the Low-Low Alarm.

13.2.3.3 Manual Mode

Any or all pumps may be operated manually by placing the HOA switch on the VFD operator interface in the HAND position. The speed of that pump can then be set on the VFD operator interface. A pump that is operating in MANUAL mode is not controlled by the PLC. However, any pump that remains in REMOTE mode will continue to be controlled by the PLC.

OPERATOR'S NOTE: MANUAL mode is only recommended when necessary because of control problems or maintenance requirements. During MANUAL mode the operator will need to continuously monitor well head pressure, flow, Reclaimed Water Tank level, etc.

13.2.4 Sequence of Operation

13.2.4.1 Automatic Operation

At the VFD operator interface, place the HAND-OFF-AUTO selector in the AUTO position.

At the HMI on the CP, select Automatic Alternation of Lead/Lag1/Lag2/Lag3 for Pumps P-26531, P-26532, P-26533, and P-26534 or manually select Lead/Lag1/lag2/Lag3 pump order. At the HMI on the CP, select Automatic for Pumps P-26531, P-26532, P-26533, and P-26534. The pumps start, stop, and vary speed automatically to maintain constant supply pressure to the Injection Wells.

13.2.4.2 Manual Operation at the VFD

At the VFD, turn the pump ON by placing the HAND-OFF-AUTO selector switch in the HAND position.

The pump operates at the last selected speed. At the VFD, adjust the speed desired using the VFD operator interface UP and DOWN arrows.

13.2.4.3 SCADA Manual Operation

At the HMI on the control panel, select desired Well Injection Pump to operate in MANUAL mode. The HOA switch remains in REMOTE.

13.2.5 Emergency Operation and Control

13.2.5.1 Pump Failure

If the PLC calls a pump to run and does not receive a RUNNING confirmation signal from the VFD, the PLC will issue an INJECTION PUMP #X MOTOR FAILED TO START alarm (X = the pump number). If the system is operating normally in Automatic mode, upon failure of any pump, the next pump in line will be enabled if the Reclaimed Water Tank water level is in the correct range.

High motor temperature in any pump will trigger an INJECTION PUMP #X MOTOR GENERAL FAULT alarm (X = the pump number), stop the motor, and disable it in all modes of operation until the fault has been cleared at the VFD.

Upon start-up from either power source, serving utility, or standby generator, there is a 10-second delay between the starts of first and second pumps and between the second and third pumps. Following a power failure or transfer between sources, pumps restart automatically in staggered fashion when power is restored.

13.2.5.2 Pump Station Alarm List

See Appendix C.

13.2.6 Start-Up/Shutdown Procedures

13.2.6.1 Operation at Start-Up

Refer to the manufacturer's O&M manual for specific instructions regarding pump installation and checks that should be made prior to initial operation of the pump.

13.2.6.2 Operation at Shutdown

During a temporary shutdown, the pump remains connected to the electricity supply. Refer to the manufacturer's O&M manual for specific instructions regarding pump installation, maintenance, and checks that should be made prior to shutdown of the pump.

13.2.7 Maintenance

Any and all maintenance performed on the pumps should be verified with the manufacturer's O&M manual. Warranty requirements could be violated if improper procedures are followed; consult the manufacturer's manual for more detailed maintenance schedules.

13.2.8 Operational Checks

The power consumption and voltage of the pumps should be monitored periodically for all three phases. An increase or a decrease in power draw beyond typical operational fluctuations can indicate damage and/or faulty operation of the impeller/propeller, bearings, and/or the motor. A closely followed schedule of checks will familiarize the operator with what average operational variability he or she can expect and what constitutes abnormal power consumption.

14. VADOSE ZONE INJECTION WELLS

This chapter discusses vadose zone injection well operation and maintenance.

14.1 System Overview

The following is a summary of how the injection wells operate:

- Not all wells are to be placed into service. Initially Well 6 will be the primary injection well and Well 4 is an automated backup. The remainder of the wells will be closed using the manual gate valve off the reclaimed water pipeline.
- When the Reclaimed Water Tank level is above set point and needs to discharge water (high level/well on set point) the primary Well 6 VSmart valve opens at a predetermined programmed flow rate.
- Each VSmart valve regulates flow to its injection well at a control-set rate throughout the day. Diurnal variation in flow can be stored in the reclaimed water reservoir. The water level in the Reclaimed Water Tank rises and lowers throughout the day to equalize rate of flow to the well. A constant injection rate is desired.
- Water is supplied to the wells by the Well Injection Pumps which are controlled to provide a set pressure in the pipe between the pumps and the wells. When the VSmart valve opens, it drops the pressure in the pipe activating the Well Injection Pumps to speed up. Because the pump pressure set point range is only a few psi, the hydropneumatic tanks do not provide significant working volume. They do, however, provide water hammer protection and system pressure backup protection.
- The primary VSmart valve in Well 6 will increase flow to the injection well(s) if necessary during peak flows if the water level in the Reclaimed Water Tank exceeds normal high water set point.
- The backup Well 4 will be placed into service if necessary during peak flows that exceed the primary Well 6 maximum flow set point and when the water level in the Reclaimed Water Tank exceeds the high water level set point.
- Monitoring wells have been located to reflect Well 6 as the primary well and Well 4 as backup. Eventually, it is expected that Wells 6 and 4 will clog due to bio-fouling (see Appendix E for hydrogeology report and recommendations). When the Tribe puts other wells in service new monitoring wells may be needed to be installed to ensure proper sampling and testing of the groundwater as required in Chapter 18. When this occurs, the Tribe shall contact EPA and notify them that a different well has been placed into service and determine if a new monitoring well is required.
- Reclaimed water not used by the WRP will be discharged to the Vadose Zone Injection Wells. There are a total of six injection wells that have been installed (Wells 2 – 7), which are located in the Resort parking lot northwest of the WRP. Well 3 has not been put in service. Well Locations are shown in Figure 14-1. Each well injects reclaimed water into the vadose zone through a 4-inch injection pipe that extends 160 feet below the ground surface (bgs). A VSmart valve located at the end of the 4-inch injection pipe (160 feet below the ground surface) provides back pressure and flow control in the injection pipe to ensure the injection pipe is at all times full (see

Section 14.2 for information regarding VSmart valve function). Hydropneumatic tanks and Well Injection Pumps supply the VSmart control valve with reclaimed water. A 12-inch perforated polyvinyl chloride (PVC) well screen that extends between 70 – 155 feet below the ground surface allows flow to pass from the 4-inch injection pipe to the surrounding soil for infiltration into the vadose zone. Injection flow rates through the well screen are limited by infiltration rates of the soil and are regulated by the VSmart valve and control system programming.

- Each well head is housed in a separate utility vault containing a VSmart valve control panel, ARI-ARV combination valve, pressure transmitter, Wye strainer, and magnetic flow meter. All wells are located at the end of individual 4-inch ductile iron (DI) pipe branches that route reclaimed water from a central 8-inch DI force main (FM). Locations of the injection wells can be found on Sheet C16 of the Record Drawings and Figure 14-1.
- Injection Wells (Table 14-1) for the facility are considered Class V injection wells by the EPA and are subject to Class V UIC program regulations and requirements as outlined in CFRs 144 – 147. Selected portions of CFR 144 are included in Appendix A for the operators' convenience. These are not the only portions of the CFR parts listed above that are applicable.

Table 14-1. Equipment and Equipment Tags for Injection Wells

Equipment Description	Tag Number
Injection Well Control Panel 1 (wells 1, 2, 5)	CP-261
Injection Well Control Panel 2 (well 6)	CP-262
Injection Well Control Panel 3 (wells 4, 7)	CP-263

14.2 Flow Control

Injected flow is controlled by a hydraulically operated VSmart valve that is mounted on the end of the injection pipe at the bottom of each well. The valve is opened and closed using hydraulic fluid lines that are connected to an electrically operated hydraulic pump package located inside the vault. Desired injection flow rates are set by the PLC control system or are manually set by the operator. Flow entering the injection well is measured and monitored by a magnetic flow meter located within the well vault which provides feedback to the PLC, the VSmart valve panel, and the SCADA system.

Because water infiltration at the injection wells occurs at a steady rate, injection flows should also be kept at a steady rate to coincide as closely as possible with the infiltration rates. To equalize diurnal variation in WRP reclaimed water flows, water is stored in the Reclaimed Water Tank to prevent temporary hydraulic overloading of the injection wells as outlined in Section 14.1, System Overview.

Operators will need to anticipate high weekend, holiday, and/or special event flow rates and make sure the Well Injection Pumps are brought on at the right time to prevent the Reclaimed Water Tank from reaching top water level when the WRP is unmanned. This will prevent unnecessary use of the backup well. If the Reclaimed Water Tank is at top water level when the Well Injection Pumps are turned on, the system's automatic response will be to turn on both Wells 6 and the backup Well 4. Using Well 4 on an intermittent basis could cause the well injection capacity to slow and plug prematurely. In a situation where the wells are brought on line with the reclaim level at top water and only one well is required, turn off the backup Well (No. 4) at the HMI panel until the water level drops to within normal operating level.

14.3 Pressure Control

Pressure monitoring/control for the system is provided by a pressure transducer on the Well Injection Pump discharge pipe which will activate the Well Injection Pumps if the pressure drops below the set point. See Chapter 13 for information regarding the Well Injection Pump system. It is imperative that positive well head pressure be maintained at a recommended minimum constant pressure of 20 to 35 pounds per square inch (psi). If pressure at the well head falls below zero (negative pressure) the well will partially, or entirely, drain and could result in air being drawn into the vadose zone, potentially reducing the infiltration capacity.

Water levels in the injection well casings are measured through a level transducer located approximately 155 feet below ground surface. The level transducer is installed through a 1.5-inch PVC pipe that is located between the 4-inch well injection pipe and the 12-inch well injection casing. A slotted PVC screen at the end of the 1.5-inch pressure transducer pipe allows water in the 1.5-inch pipe to reflect the water level between the 4-inch well injection pipe and the 12-inch well casing. Should the reclaimed water reach 30 feet below ground surface, the VSmart valve is programmed to reduce flow to prevent reclaimed water from rising above this level or reaching the well head.

14.4 Initial Well Use

For initial plant operations, Well 6 will be the primary active injection well for reclaimed water, and Well 4 will be designated as the initial backup well. To achieve this system configuration, the gate isolation valves for all other injection wells are to be closed except for Well 6 and Well 4. These gate valves are located in the west parking lot where the 4-inch well supply pipes branch from the main 8-inch reclaimed water FM.

Parametrix DATE: March 30, 2017 FILE: PS7367002F14-1

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SCALE IN FEET

LEGEND

- INITIAL WELL INSTALLATIONS
- FUTURE WELL INSTALLATIONS
- WELL SPACING RADIUS

Figure 14-1
Monitoring Well Location Plan
Cowlitz Reservation Development

14.5 Long-Term Well Use and Clogging

Over time, operating water levels in the injection wells will rise as infiltration rates slow because clogging occurs. The rate of clogging can only be assessed as the wells are operated and monitored. Injection Well 6 is considered to be at the end of its operational life when the gravity water level gets within 30 feet of the ground surface AND the infiltration rate drops to 25% of average daily flow (see Reclaimed Water Infiltration Well As-Built Report by Pacific Groundwater Group, Appendix E). When both of these conditions have been met, primary injection well status should be transferred to injection Well 4 and injection Well 6 should be made the backup well or a new well should be activated for backup. Additionally, EPA should be notified that a new well has been put online, as they may require placement of a new monitoring well within the well field to properly capture the plume. When an injection well has met the end of its operational life, it shall be rehabilitated based upon recommendations of a licensed hydrogeologist or decommissioned in accordance with EPA or Washington State Department of Ecology.

In addition to the seven injection wells that have been constructed, four additional injection wells (Wells 8, 9, 10, and 11) are planned for future installation. To deliver reclaimed water to these future well sites, 4-inch DI piping was installed during initial construction. When these wells are needed, contact the design engineer (Parametrix) and the project hydrogeologist for drilling and installation guidance for these additional wells.

14.6 Injection Well 1

Injection Well 1 differs from the other six injection wells on-site. Unlike the other injection wells on-site, the control valve is located within the well head vault and not at the bottom of the well. Additionally, the well injection pipe is only 1.5-inch diameter and only extends to 146 feet below the ground surface. This well should at all times be closed off from receiving flow except during the highly unlikely scenario that all other injection wells are malfunctioning. Well 1 has not been constructed during the initial phase of the Casino due to the better than expected production of Wells 2 through 7.

14.7 Monitoring Wells

EPA mandates under their UIC Class V injection control plan, that monitoring wells be placed both up gradient and down gradient of the injection wells. The purpose of these monitoring wells is to ensure that reclaimed water injected into the vadose zone is in compliance with EPA regulations. The up gradient monitoring wells are utilized to obtain aquifer water samples to establish natural water quality levels. Down gradient monitoring wells are utilized to confirm that reclaimed water entering the aquifer is not negatively impacting aquifer water quality.

The initial facility configuration places one monitoring well upstream of the injection well field for background water sampling and two monitoring wells down gradient of the well injection fields for sampling groundwater after injection activities. These wells are located at the following coordinates:

- MW-1: N 197788.84, E 1077291.03
- MW-2: N 196990.78, E 1077685.10
- MW-B-1: N 196139.44, E 1079057.99

Each 6-inch steel monitoring well casing is approximately 300 feet deep and houses a 1.25-inch pipe located 290 feet below the ground surface. Sampling and testing procedures as described in Chapter 18 will need to be performed at each of these wells on a regular schedule as set forth by the EPA.

14.8 Maintenance

Magnetic flow meters, pressure transducers, VSmart valves, VSmart control panels, ARI-ARV combination valves, and wye strainers are all located within each well vault and will require regular maintenance to ensure proper functionality.

- **VSmart Valves –** Manually exercise all VSmart valves in the field at the frequency specified by the manufacturer to ensure the valve is functioning correctly. Before exercising each valve, first manually close the 4-inch gate valve to ensure no flow is going to the injection well. Alternatively, VSmart valves can be programmed to automatically and remotely exercise through the VSmart control panels. If automatic exercising of these valves is desired, coordination with Parametrix programmers will be necessary.
- **ARI-ARV Valves –** Exercise each ARI-ARV valve on a regular basis to ensure proper functionality.
- **Gate Valves –** All gate valves located in the well injection field should be regularly exercised. For inactive injection wells, the VSmart valves should remain in the closed position during exercising of the gate valves. When gate valve exercising is complete, verify that the gate valves for the active and backup wells are open, and all other gate valves are closed.
- **Wye Strainer –** On a regular basis, strainers for active injection wells will require cleaning to rid the filter screen of built up debris. Before cleaning strainers, first close the 4-inch gate valve located at the 4-inch by 8-inch tee for the injection to prevent flow to the well. Unflange the strainer downspout, pull out the screen, clean the screen, reinsert the screen, and re-bolt the downspout cap.

For each of the above devices, follow the manufacturers recommended maintenance procedures and schedules as outlined in the manufacturer’s O&M Manual.

14.9 Trouble Shooting

It is critical to keep the vadose zone well system operational and to maintain reclaimed water quality prior to injection in the vadose zone wells. The scenarios listed below can impact one or both of these critical functions. Should the remediation actions recommended in the troubleshooting list below not fully address the injection well scenario at hand, or should the recommended actions not fix the problem, contact the project design engineer (Parametrix) for further direction.

- **High Turbidity Trains 1 and/or 2 –** Permeate Pumps to Trains 1 and/or 2 stop due to high turbidity events above 0.2 Nephelometric Turbidity Units (NTU) and wastewater beginning to store in Cells 3 and 4. Shut off impacted cassette(s) in each train using manual valves and put unaffected cassette(s) back in service. High turbidity water should not be sent to the injection wells. Correct affected cassette(s) during lower flow conditions.
- **High Water Level in Reclaimed Water Tank/Wells Indicate Normal Operation –** Check communication between wells and WRP to make sure the control system is operating correctly. The operator may need to open wells manually if communication is lost, and put the

communication system back in service as soon as possible. Check to make sure primary and backup wells are operating correctly. Make sure that manual valves to primary and backup wells were not closed.

- **High Plant Flow/High Water Level in Reclaimed Water Tank/Primary and Backup Well in Use –** Check for proper operation of the wells as outlined. If flow at the WRP exceeds the capacity of the wells, open the manual value to one of the standby wells and reprogram the system to have two primary wells and a new backup.
- **High Water Level in Well Casing Annular Space/Normal Flow Conditions –** Check for long-term well clogging (low flow and high water level) in primary and/or backup well. If flow and water level exceed recommendations in this chapter, consider placing a different well in service for primary and/or backup. Consult engineer and hydrogeologist for long-term use of the well(s). If different well(s) is used for a primary well, the Tribe shall consult EPA to determine if a new monitoring well(s) for primary drinking water groundwater sampling and testing is required.
- **Low Water Level in Well Casing Annular Space/High Flow at Well Meter –** Check to see if VSmart valve is properly restricting flow to the well or if communication between the well and WRP was lost. This could also be a result of a VSmart valve stuck open or damaged VSmart seal.
- **Low Water Level in Reclaimed Water Tank/Reclaimed Water Pumps Cycling/Possible High Water Level in Well Casing Annular Space –** Check to make sure the primary or backup well VSmart valve is properly controlling flow to the well(s). VSmart valve could be open causing excessive flow to the primary well. Close manual valve to primary well and use backup well. Open manual valve to one of the standby wells for automated backup. Correct VSmart Valve.
- **Loss of Power to VSmart Valves –** Open manual valve to Well 1 and put into service if installed or provide backup power to VSmart control valve panel and open VSmart valve using local control panel.
- **Low flow through VSmart valve, but Valve and Controls Appear to be OK –** At well head vault, open the tap at the bottom of the 4-inch gooseneck influent pipe structure. If it shows indications that the gooseneck is full of gravel or other obstruction; isolate the well, remove the gooseneck pipe, and clean before replacing. See Figure 14-2 on the following page.

Figure 14-2. Typical Injection Well Vault

15. AUXILIARY SYSTEMS

15.1 Plant Automatic Wastewater Samplers

The WRP Headworks (influent), Mechanical Room (post UV disinfection) and Well Injection Pump Room samplers are automated composite refrigerated samplers. The influent sampler is located at the Headworks and samples from the headworks channel downstream of screen. The Post UV sampler samples reclaimed water from downstream of the UV disinfection. The Well Injection Pump sampler pulls samples from just downstream of the Well Injection Pumps. The samplers' function, physical description, operation, and controls are included in the manufacturer's literature and are briefly summarized below:

- The Influent and Mechanical Room automatic samplers are contained in refrigerated fiberglass enclosures and consist of the following: vacuum pump, single or multiple sample containers, control valves, and circuitry. The Well Injection Pump effluent sampler is not refrigerated.
- The influent sampler receives a 4 to 20 mA signal from the influent flow meter (FE20220); the post UV sampler receives a 4 to 20 mA signal from the Permeate Pump flow meters (FIQR26104 and FIQR26114), and the Well Injection Pump sampler receives a 4 to 20 mA signal from the injection well flow meter (FE 26540). The programmable computer in the sampler will convert the mA signal to a pulse duration contact closure.
- When the sampler is controlled by the timer, it will sample every time the timer times out. When the timer times out, it automatically resets and begins timing again. Under normal operation, the samplers should be set to operate by the flow meters (because flows are intermittent) except when the flow metering system is malfunctioning or a special plant performance and monitoring study is being performed.

15.2 Drains and Grinder Pump Station

15.2.1 Overview and Design Criteria

Each process tank is equipped with a 4-inch manually-operated mud valve that drains via gravity to the Influent Pump Station. The drains in the Operations Building, Mechanical Room, Utilidor, and the Sludge Loadout Area all drain to the Grinder Pump Station north of the building.

OPERATOR'S NOTE: There are no check valves on the drain lines to the Grinder Pump Stations. If the grinder pump receives high flows that the pump cannot keep up with, wastewater will back into the lines and through the drains.

The E-1 submersible pump (P28000) grinds and pumps drain flows through a 1.5-inch force main back to the headworks for screening.

Table 15-1 provides the design criteria for the grinder pumps.

Table 15-1. Grinder Pump Design Criteria

Type	Submersible
Number	1
Flow Rate (gpm)	12 at 29-foot TDH
Discharge Pressure (approximate, psi)	15
Motor	1 hp, 240 V, 1-Phase, 60 Hz

15.2.2 Normal Operation Controls

The Grinder Pump Station is a fill-and-draw pump station, based on level switches. There are three level switches in the pump station that determine the following conditions:

- Low-Level (LSL28000): Pump off.
- Pump On (LSH28000): Pump on, no alarm.
- High-High Water Alarm (LSHH28000): Alarm.

The Grinder Pump Station has its own control panel, CP-280. A complete shelf-spare pump has also been provided.

When “Automatic Alternation” is selected via the HMI, the PLC will operate the system in Automatic mode.

15.2.2.1 Automatic Operation

For automatic operation:

1. With the Control Panel placed in the AUTO position, the pump will be controlled automatically by CP-280 based on the wet well level float switches and the PLC to maintain wet well level.
2. In the Automatic mode, the pump is automatically staged to maintain water surface elevation in the wet well below the invert of the floor drains.

15.2.3 Emergency Operations and Workarounds

In the event of a chemical spill, operate the pump in manual and slowly meter flows back to the headworks of the WRP. This will reduce the likelihood of process disruptions. To protect the process from chemicals, the Chemical Room trench drain flows to the chemical drain manhole which has to be emptied by pump.

In the unlikely event of a catastrophic failure of the pump, temporary pipe and pump systems are infeasible. Repairs or replacement of the pump is a high priority.

15.3 Hoisting Equipment

Hoisting equipment is provided to facilitate heavy equipment retrieval and maintenance as required. There are two monorails and a bridge crane in addition to several smaller hoists around the WRP. The hoisting equipment applications and capacities are outlined in Table 15-2.

Table 15-2. Hoisting Equipment

Description	ID	Weight Capacity (ton)	Lift Range (feet)	Reach	Application
Headworks – Manual underhung monorail hoist		2	10	North wall of Electrical Room to north edge of headworks slab	Lifting fine screen drums at headworks
MBR Bridge Crane – Motorized trolley and chain hoist		3.5	39	Full width of MBR process tanks plus 12 feet on each side of tanks	Retrieving/installing MBR cassettes
Mechanical Room – Underhung monorail, motorized hoist		1	16	Mounted over blowers	Lifting/installing blower components or motor

15.4 HVAC Systems

Heating and ventilation equipment is installed in the Operations Building and the Electrical, Chemical, Mechanical, and Administration Rooms. The major components of the HVAC system are:

- Split system condenser/air handling unit.
- Split system chilled water/air handling unit.
- Unit heaters.
- Wall heaters.
- Exhaust fans and duct work.

Table 15-3 provides a schedule of HVAC components and capacities.

Table 15-3. HVAC Schedule

Equipment Number	Location	Description	Capacity Heating/Cooling	CFM	Fan Power (hp)
UH-28110	Operations Building; Utilidor	Unit Heater	7.5 kW		
UH-28111	Operations Building; Mechanical Room	Unit Heater	15 kW		
UH-28112	Operations Building; Mechanical Room	Unit Heater	15 kW		
UH-28113	Injection Pump Room	Unit Heater	2 kW		
WH-28234	Operations Building; Locker Room	Unit Heater	1.5 kW		
WH-28235	Operations Building; Men's Toilet Room	Wall Heater	1.5 kW		
WH-28236	Operations Building; Women's Toilet Room	Wall Heater	1.5 kW		
UH-28331	Operations Building; Chemical Room	Wall Heater	3 kW		
AHU-28210	Operations Building; Mezzanine	Air Handling Unit		2,200	1
AHU-28212	Operations Building; Mezzanine	Air Handling Unit	15 kW	1,900	3
CCU-28210	Yard; North of Operations Building	Condensing Unit	26.0/55.2 MBH		
CCU-28212	Yard; North of Operations Building	Chilling Unit	21.0/30.0 MBH		
VAV-28220	Operations Building; Administration Rooms	Variable Air Volume Unit	3 kW	600	
VAV-28222	Operations Building; Administration Rooms	Variable Air Volume Unit	3 kW	400	
VAV-28224	Operations Building; Administration Rooms	Variable Air Volume Unit	1 kW	180	
VAV-28226	Operations Building; Administration Rooms	Variable Air Volume Unit	3 kW	600	
AC-28001	Headworks; Electrical Room	Air Conditioner	9.0/13.0		
EF-28114	Operations Building; Mechanical Room	Fan		4,100	1
EF-28115	Injection Pump Room	Fan		270	.25
CF-28116	Operations Building; Mechanical Room	Fan		N/A	1
EF-28231	Operations Building; Locker Room	Fan		200	0.25
EF-28233	Operations Building; Laboratory	Fan		450	0.25
FH-28236	Operations Building; Laboratory	Fan		450	0.33
EF-28330	Operations Building; Chemical Room	Fan		300	0.5

15.5 Reuse Water System

The reuse water system and its components are located throughout the WRP. Refer to Sheets C9 and C10 of the Record Drawings for the locations of all exterior hose bibbs. Sheet P11 provides the process flow for the reuse water system.

The reuse water system supplies reclaimed water for the headworks fine screen spray wash, anoxic and Aeration Tank spray nozzles, and dilution water for the Mazzei CIP system, in addition to general plant maintenance. Frost-free hose bibb stations are strategically located at each major process component to facilitate equipment and workstation wash down. Treated and UV disinfected water is chlorinated prior to flowing into the Reclaimed Water Tank. The reuse water is drawn from the Reclaimed Water Tank by the Reuse Water Pumps 1, 2, or 3 and piped to the rest of the distribution system through a 3-inch PVC main.

The Reuse Water Pump system also has a hydropneumatic tank (T-26501) designed to provide surge dampening and pressurized storage for the reuse water system.

The reclaimed water is chlorinated prior to entering the Reclaimed Water Tank. The chlorination system is in the Chemical Room. The system operates with a 35-gallon day tank which provides storage for stock sodium hypochlorite solution (12.5 percent) that is injected into the 8-inch reclaimed water pipe, upstream of the Reclaimed Water tank, for residual disinfection. A skid-mounted sodium hypochlorite feed system in the Chemical Room includes three chlorine metering pumps, valves, and controls for the dosing system. One pump is for post UV injection, one pump is for post Well Injection Pump injection, and the third pump is a standby pump for either. Sodium hypochlorite from the day tank is pumped with a diaphragm metering pump through a 3/8-inch pipe to the injection point. The dosing pump will begin pumping when the permeate flow starts, and will shut off when flow stops. The chlorine pump rate is manually adjusted to provide adequate chlorine residual in the reuse water system piping. Design criteria for the reuse water system is shown in Table 15-4.

Table 15-4. Design Criteria for the Reuse Water System

Reuse Water Pumps	
Type	Vertical Multi-stage
Number	3
Flow Rate (gpm)	40 at 200 feet TDH
Motor	5 hp 480 V, 3-Phase, 60 Hz
Hydropneumatic Tank	**No Manufacturer Data**
Type	ASME pre-charged bladder-type
Number	1
Maximum Pressure (psi)	150
Volume (gallons)	35

OPERATOR'S NOTE: The reuse water is chlorinated to provide protection for the operators.

15.6 Potable Water System

The potable water system for the WRP was not detailed in the design drawings. See Sheet M315 of the Record Drawings for a schematic isometric drawing of the system. The potable water sources/lines at the WRP are the Operations Building lavatory, showers, laundry, and the emergency eyewash outside the Chemical Room. The laboratory water lines are backflow protected with double check valves and vacuum breakers on the faucets. There are also provisions for a future potable water make-up pipe with air gap to charge the Reclaimed Water Tank in the event it reaches alarm low water level.

16. INSTRUMENTATION AND CONTROLS

Three main control panels are provided at the WRP: Headworks CP-210; Operations CP-201; and Kubota MBR CP-202. Five sub-control panels control subsystems: Fine Screens CP-211; Reuse Water Skid CP-263; and UV unit 2 CP-204B. The P&IDs supplied as part of this O&M manual in Appendix B show which equipment is connected to which control panels. Table 3-3 summarizes which equipment is controlled at which control panel.

OPERATOR'S NOTE: This section provides an overall summary of the WRP instrumentation and controls, general monitoring and control procedures, alarms, and troubleshooting. Control of individual equipment components and processes is discussed in detail in Chapters 5 through 15. Printouts of the SCADA screens for each of the WRP processes are provided in Appendix D.

16.1 Operator Interface Functions

The WRP SCADA system is operated using HMI software called System Platform, which allows the operator to observe and control plant processes from the computer workstations. There are three main control panels. Control stations are located in the office and on the HMIs of control panels CP-210 and CP-202.

OPERATOR'S NOTE: All of the process controls for the WRP are contained in the PLCs and not in the computer workstations. Therefore, loss of computer operation (i.e., rebooting) will only result in a loss of data collection, display of process information, and alarm notification. The PLCs will continue to run the WRP processes during a computer reboot.

16.2 Human-Machine Interface (HMI)

In its simplest form, each SCADA screen represents an area or section of the treatment process. An example of this includes the following:

- From the overview screen, place your pointer within the square that represents the Influent Pump Station and left click; when using one of the two HMI touch panels, touch this area.
- The screen will change to a more detailed view of the Influent Pump Station as shown in Appendix D, Figure D-3.
- To return to the overview screen, left click the "Overview" button located on the main menu.

There are different login levels that are used to view and/or control plant processes. The operator and administrator levels, which allow process and control changes, require a login password. The login levels are summarized in Table 16-1.

Table 16-1. Login Access Levels

Level	Login Password Required	Description
View Only	No	Process can be viewed but not controlled.
Chief Operator	Yes	All plant screens, trends, and controls are available. Motors and valves that are remote controlled may be started and stopped or opened and closed. Start and Stop MBR System. Acknowledge Alarms.
Operator Type A	Yes	All plant screens, trends, and controls are available. Motors and valves that are remote controlled may be started and stopped or opened and closed. Acknowledge Alarms.
Operator Type B	Yes	Process can be viewed but not controlled. Acknowledge Alarms.

Other local HMIs provide manual control, status, and settings for designated systems. These HMIs are listed here:

- Headworks Electrical Room:
  - CP-210 Headworks and Operations Building (excluding MBR).
  - CP-211 Fine Screens.
- Operations Electrical Room:
  - CP-201 Headworks and Operations Building (excluding MBR).
  - CP-202 MBR Process.
- Operations Building Mechanical Room:
  - CP-204B UV Stream 2.
  - CP-263 Reuse Water Pump Skid.
- Outside Northeast Corner of Operations Building:
  - CP-278 Solids Tank Load to Truck.

16.3 Historical Trending

The SCADA system continuously collects data for process variables such as tank and channel levels, flow rate, pressure, and discrete events such as motor start/stops and valve opening/closing. Trends of these variables and events can be very useful in providing operating and troubleshooting information. Some of the WRP trend screens are shown in Appendix D, Figures D-21 through D-32.

16.4 Alarms

This section provides information related to how the alarms are accessed and viewed on the SCADA system screens. See Appendix C for a list and description of equipment alarms.

When a new alarm occurs, the “alarm” will be visible in the top center of any SCADA screen. Any alarm that is “active” and has not been acknowledged will appear in this location and have red colored text (see Appendix D, Figure D-1 for an example). An alarm that clears but has not been acknowledged will show in this section as green. WIN-911 Dial-out software will wait 30 seconds after an alarm occurs before attempting to dial the on-call phone list, giving an operator a chance to acknowledge the alarm at the SCADA HMI station. Once WIN-911 starts dialing the on-call list, it will continue down the call list until an operator acknowledges the alarm. Once acknowledged, the alarm text color will turn green, indicating the alarm is still active but acknowledged. The Alarm Summary screen, accessed by selecting the Alarm button on the main menu, shows all active or unacknowledged alarms. A Historical Alarm list can be viewed by going to the Alarm Summary list and selecting the Alarm History button.

16.5 Local Control of Equipment

Some equipment has the ability to be run locally. Within the Headworks for example, local JOR selector switches are available for the drum screens. For normal operation, these selectors would be placed in the remote position. An operator has the ability to jog the equipment holding the selector switch to the jog position. As long as the operator holds the selector in the jog position, the equipment will run. Releasing the selector switch will return it to the off position, stopping the equipment. Once done, the operator must return the selector to the remote position for automatic operation.

OPERATOR'S NOTE: Caution must be taken when "jogging" equipment. Jog is a manual operation and it is the operator's responsibility to not damage the equipment.

16.6 Plant Control System

16.6.1 General

Alarms and set point activations will require a minimum of 5 seconds for the set point/alarm level to be met before the set point/alarm will be activated. This is to ensure the process variable is stable.

Each analog signal will be logged for trending.

16.6.2 Hand/Off/Auto (HOA) Switch

For operation of the HOA switch:

1. Run equipment continuously when in the HAND position.
2. Stop and do not run equipment when in the OFF position.
3. Control equipment as described in the paragraphs below when in the AUTO position.
4. Generate an alarm if a piece of equipment switch is not in AUTO.

16.6.3 Lead/Lag/Standby Equipment

For operation of the lead/lag/standby equipment:

1. Lead – Primary piece of equipment to start first in the sequence.
2. Lag – Second piece of equipment to start in the sequence. Typically this will operate concurrently with the lead piece of equipment.
3. Standby – Piece of equipment that will operate to replace either the lead or lag equipment when a failure occurs with either one.
4. Operator Interface – Status display to show the position of each piece of equipment in the sequence.

5. Equipment Order Selection Switch:
    a. Manual Selection – When this is selected, the operator is able to manually select the order of the equipment. Order of the equipment will remain the same until the operator manually selects a new sequence.
    b. Automatic Alternation – When this is selected, the sequence is rotated automatically between pieces of equipment.

16.6.4 Valve Failure Alarm

1. When a valve is required to open or close to a certain position (typically fully open or fully closed), a timer is set for the length of travel time for the valve plus 15 percent. If the valve does not achieve its position within this time, a valve failure alarm is generated.
2. A failure alarm will remain active until a reset occurs. The failure is reset when the valve is “not in auto” at either the HMI or the physical switch in the field.

16.6.5 Pump/Blower Failure

1. When a pump/blower is called to run, a timer is set, typically for 10 seconds. If a run feedback signal does not come back from the pump/blower motor control circuit in that time, the system will remove the run command and trigger a pump/blower failure.
2. A failure alarm will remain active until a reset occurs. The failure is reset when the pump/blower is “not in auto” at either the HMI or the physical switch in the field.

16.6.6 Level Transducer Primary/Backup

When a tank contains two level transducers for redundancy, primary/backup control of the level transducers for level indication/control is as follows:

1. An operator switch is provided to select the primary/backup level transducer.
    a. The primary level transducer will switch to the backup level transducer when any of the following events occurs:
        (1) Loss of 4-20 mA signal.
        (2) High level alarm float is triggered.
        (3) Low level alarm float is triggered.
2. An alarm is triggered if the difference in level readings from the two transducers is greater than 0.2 feet.

16.7 Headworks

16.7.1 Screening

16.7.1.1 Overview

The fine screen system consists of two screens to remove non-organic solids from the wastewater influent. Each screen is designed for plant build-out flows. Only one screen will be in use at one time.

The entire screening system is controlled by the manufacturer's supplied control panel, CP-211. The control panel has its own PLC. Information on the PLC is available to the SCADA system via an Ethernet connection.

16.7.1.2 Normal Operation and Control

The fine screen and screenings compactor are used to screen, convey, and dewater influent solids of 2 millimeter size and larger. The units are controlled by level sensors in the influent channel ahead of each fine screen (LE20111 and LE20121).

During normal operation, suspended solids are trapped on the inside diameter of the submerged screen basket. The trapped solids cause the screen to "blind," resulting in a rise in channel level. Regardless of the flow rate, once the upstream water level reaches the set point, the influent level sensors will activate the screen cleaning operation and the following sequence of events occurs:

1. The screen starts 5 seconds after the influent screen's operating level is reached.
2. Five seconds after the screw forward command has been issued, the lower wash solenoid valve opens for 6 seconds.
3. Five seconds after the lower wash solenoid valve opens, the screen wash solenoid valve opens and remains open for 6 seconds.

This cycle continues on a 60-second interval until the influent level goes below the operating level. As the upstream water level drops below the influent screen operating level, the following sequence starts:

1. Twenty-four seconds after the last screen washing, the lower wash solenoid valve opens for 6 seconds.
2. Five seconds after the lower wash valve starts, the screen wash valve is opened for 5 seconds.
3. Four seconds after the screen wash valve opens, the screen stops and the dewater wash valve is opened for 11 seconds.

Dewatered screenings are deposited in a wheeled canister which requires emptying by the operator. Dewatered solids are hauled for landfill disposal.

16.7.1.3 Automatic Operation

For automatic operation:

1. At the local control station, place the screen and solenoid valve HAND-OFF-AUTO selector switches in the AUTO position.
2. At the SCADA HMI:
    a. Information on the SCADA HMI is read only. The select button and indicator is operator controlled to remind the operator which screen is being utilized.
    b. To select which screen is used, follow step 1 above at CP-211, open the slide gate in front of the selected screen, and close the gate in front of the NON-selected screen. This forces the water to the selected screen. The non-selected screen will function if the water overflows the gate.

16.7.2 Grit Removal

There is currently no controlled grit removal equipment in the Headworks. The WRP design provides for future installation of a grit pump and classifier in the existing grit chamber. When this equipment is installed, this O&M Manual should be revised to include control descriptions for the grit removal system.

16.8 Influent Pump Station

16.8.1 Overview

The Influent Pump Station consists of three pumps. These pumps operate in a lead/lag/standby fashion. The wet well contains two level transducers for redundancy. The primary/backup control scheme is used for the level transducers for level indication/control. The wet well contains two floats: one for high water level alarm and one for low water level alarm. When the low water level alarm is triggered, the pumps shut off until the wet well level is above the low level set point.

16.8.2 Normal Operation and Control

With the HAND-OFF-AUTO (HOA) switch on the VFD operator interface placed in the AUTO position, the three pumps will be controlled automatically by CP-210 based on the wet well level transmitters and the PLC. This will maintain a nearly constant wet well level at the operator adjustable set point. During Continuous Level Control mode, the number of pumps operating and the pump speeds are varied by a PID control loop in the PLC to maintain a constant level in the wet well. When the pumps are first engaged, the pumps will start at the speed set by the PID controller. This will most likely be the minimum pump speed; however, the pumps will not maintain the minimum speed for an extended period of time. The pumps will operate in Continuous Level Control mode unless a failure of the system occurs. The operator adjustable set points based on selected primary wet well level transducer are as follows:

1. High Level Alarm >= 8 feet 0 inch.
2. Maintain Wet Well Level = 5 feet 0 inch.
3. Lead Stop <= 3 feet 0 inch.
4. Low Level Alarm <= 2 feet 9 inches.

Other settings available to the operator:

1. Auto Alternation On/Off Push Button.
2. Lead Change Push Button.
3. Days and Time for Auto Alternation.

16.9 Equalization Tank for Peak Flow Diversion

There is currently no equalization tank installed at the WRP. Equalization is currently provided in the unequipped process tanks in treatment Trains 3 and 4 as described in Chapter 7. The WRP design provides for future installation of an above-ground equalization tank where peak flows can be directed automatically. When this equipment is installed, this O&M Manual should be revised to include control descriptions for the equalization tank system.

16.10 Biological Treatment Train – Anoxic, Aeration, and Bioreactor (MBR) Tanks

The entire treatment system is controlled by the manufacturer's control panel (CP-202). See the Kubota O&M Manual for detailed description of the treatment process controls.

The equipment not controlled by the MBR manufacturer's control panel is listed below:

1. Splitter Channel to Influent Sewer Flow Meter (FT/FE-20220):
    a. Record and display data from this flow meter on the SCADA HMI.
    b. No automatic controls or alarms are associated with this flow meter.

16.11 Solids Handling

16.11.1 WAS Feed Pumps (P-27801 and P-27802)

For operation of the WAS Feed Pumps:

1. The WAS Pumps provide wasting from the MLR channel to the Solids Tank.
2. When in Auto, the following occurs:
    a. Pumps operate in lead/standby position.
    b. The lead pump starts when either of the following occur:
        (1) Operator adjustable start time of day set point is equal to current time. Set point is adjustable in both hours and minutes to set the time of day.
        (2) Operator's momentary push button on the HMI manually starts wasting.
3. The lead pump stops when the operator adjustable WAS set point (in 5-gallon increments) is equal to or less than the total gallons metered.
4. Flow is totalized in gallons using flow meter FT/FE-21401. The total is reset at the same time the lead pump is started. The total is displayed on HMI screens.
5. The pumps are prohibited from running (either from the floats or level transducer) when a Solids Tank high level alarm is active.

16.11.2 Solids Tank Blower (B-27804)

For operation of the Solids Tank blower:

1. The blower provides mixing and aeration to the Solids Tank.
2. When in automatic operation, the blower operates as follows:
    a. The blower turns on at an operator adjustable interval set point (hours between starts).
    b. The blower turns off at an operator adjustable duration set point (minutes of blower run time).

3. The blower will shut down if a “Blower Air Temperature High” alarm is triggered.
4. There is an operator adjustable set point for “Blower Level Cutout.” When the level in the Solids Tank is at or below this set point, blower operation is prohibited. When the level in the Solids Tank is greater than this set point, the blower will operate per the controls above.

16.11.3 Solids Tank

For operation of the Solids Tank:

1. High Level Alarm – An alarm is triggered based on the following:
   a. Float LSH-27805.
   b. Operator adjustable set point for high level alarm. An alarm triggers when LT/LE-27803 level is >= set point.
2. Low Level Alarm – An alarm is triggered based on the following:
   a. Float LSLL-27805.
   b. Operator adjustable set point for low level alarm. An alarm triggers when LT/LE-27803 level is < set point.

16.11.4 WAS Loading Pumps (CP-278, P-27807)

For operation of the WAS Loading Pumps:

1. The WAS pump pumps solids into trucks for hauling off-site.
2. When in Auto operate, the pump operates as follows:
   a. Start pump when start/stop input from CP-278 is energized.
   b. Stop pump when start/stop input from CP-278 is de-energized.
   c. While the pump is running, a totalizer pulse is sent for every 5 gallons from CP-201 to the CP-278 display totalizer. The totalizer pulse is based on the flow total from flow meter FT/FE-27801.
3. Pumps are prohibited from running when a Solids Tank low level alarm (either from the floats or level transducer) is active.
4. The Solids Tank wet well level is sent via a 4-20 mA analog signal to CP-278. The signal is ranged to be the same as the Solids Tank level transducer.

16.12 UV Disinfection System

16.12.1 Overview

The UV system is comprised of one UV system, with capacity for two UV banks. Only one bank is currently installed (Unit 2). This UV bank is controlled with its own control panel, CP-204B. This control panel handles the control, status, and alarm generation for the UV system. The UV system also includes a recirculating pump to keep liquid in the UV chambers when the WRP is not permeating. In the future, as flow capacity requires, a second UV bank will be installed, controlled by CP-204A.

16.12.2 Normal Operation and Control

Plant permeate flow rate (the sum of the Kubota permeate flow meters) is sent to the UV system control panel. Permeate flow rate is scaled to the full range of the summed flow meters. This flow rate is used by the UV control panel to automatically adjust the level of UV intensity required.

Prior to operation of the Permeate Pumps on the MBR, a start command will be issued by CP-202 to the UV system and to the Operations CP-201, opening the valve upstream of the UV stream. Once the valve is open, the UV lamps will begin a warm-up time and a UV ready signal will be sent to CP-202 to allow for Permeate Pumps to operate.

When the Permeate Pumps are finished operating, CP-202 will remove the start command from the UV system. This will signal the shutdown operation for the UV system and close the upstream valve until the next start command is required from CP-202. Removal of the start command from the UV system also starts the UV recirculation pump, which operates continuously until the next UV start command.

16.12.3 Automatic Operation

For automatic operation:

1. At the UV system control valve, place the Local-Off-Remote switches in REMOTE.
2. At the UV system control panel, place the system in AUTO.
3. At the SCADA HMI, if the UV system control valve is not in REMOTE and/or the UV system control panel is not in AUTO, the UV system will not operate.
4. Start the UV system lamp warm-up and stop the recirculation pump when the start command from CP-202 is issued.
5. Generate the ready command to CP-202 from the UV system after the upstream valve is open.
6. Stop the UV system, close the valve, and start the recirculation pump when CP-202 removes the start command.

16.13 Chemical Feed Systems

16.13.1 Sodium Hypochlorite System

For operation of the sodium hypochlorite system:

1. The sodium hypochlorite drum pump and day tank operate in a hardwired fashion with their own control panel. Status inputs for the tank level are hardwired back to CP-201 for alarm and status indication on the HMI.
2. There are two injection points for chlorine solution (CLS): In the reclaimed water line between the UV System and the Reclaimed Water Tank (UV Stream); and in the reclaimed water line immediately downstream of the Reclaimed Water Injection Pumps (Injection Wells Stream).
3. Pump 1 (P-29021) is used for injection to the UV stream.
4. Pump 3 (P-29023) is used for injection to the Injection Wells stream.

5. Pump 2 (P-29022) is a swing pump and can be used with either Pump 1 or Pump 3 in a Lead/Standby mode. Selection is made on the HMI with a manual valve configuration at the Metering Pump skid.
6. When in Auto the lead pump operates as follows:
    a. Selection will be manually alternated (no auto alternation).
    b. Start lead pump when:
        (1) UV Stream – Permeate active and flow detected.
        (2) Injection Well Stream – Injection Pump running and flow detected.
    c. Stop lead pump when:
        (1) UV Stream – Permeate not active and flow not detected.
        (2) Injection Well Stream – Injection Pump not running and flow not detected.
    d. Speed control of pump to be automatically set as a linear ratio to the flow at the injection point.
    e. Operator may adjust the injection ratio by a factor of .7 – 1.3 (+or- 30 percent).
    f. If the lead pump fails and the pump is in Lead/Standby mode with Pump 2, the Standby will run as Lead.
7. When in Manual the pump operates as follows:
    a. Start the pump by pushing the Start push button on the Pump Control panel.
    b. Stop the pump by pushing the Stop push button on the Pump Control panel.
    c. Speed control of pump is set at the Manual speed set point on the Pump Control panel.

16.13.2 Magnesium Hydroxide System

For operation of the magnesium hydroxide system:

1. Filling of the storage tank using the drum pump is a manual process performed by the operator.
2. The mixer (MXR-29031) remains on at all times to keep the magnesium hydroxide solution in suspension. Operation of the mixer is also a manual process performed by the operator.
3. When in Auto operate, the magnesium hydroxide feed pumps (P-29041 and P-29042) operate as follows:
    a. Pumps will operate in lead/standby position. Selection will be manually alternated by the operator (no auto alternation).
    b. The lead pump will run continuously.
    c. The set speed control of the lead pump will be linear to the flow rate from the Influent Pump Station flow meter (FT/FE-20303).

16.14 Reclaimed Water Tank

All reclaimed water produced by the WRP is routed to the Reclaimed Water Tank. The Reclaimed Water Tank supplies the WRP reuse water system and stores Reclaimed Water prior to injection in the Vadose Zone Injection Wells. The Reclaimed Water Tank control system consists of:

1. Two level transducers for primary/backup level indication/control.
2. High Level Alarm – The alarm is triggered based on the following:
    a. Float LSHH-26201.
    b. Operator adjustable set point for high level alarm. Triggered when the selected primary level transducer (LT/LE-26202 or LT/LE-26203) level is >= set point.
3. Low Level Alarm – The alarm is triggered based on the following:
    a. Float LSLL-26201.
    b. Operator Adjustable Set Point for Low Level Alarm – Triggered when the selected primary level transducer (LT/LE-26202 or LT/LE-26203) level is < set point.
4. Low Level Flow:
    a. Operator adjustable set point for Low Level Flow.
    b. Reduce Well Injection Pump Station flow when selected primary level transducer (LT/LE-26202 or LT/LE-26203) level is < set point.
    c. Increase (Return) Well Injection Pump Station flow to Baseline when selected primary level transducer (LT/LE-26202 or LT/LE-26203) level is > set point.
5. High Level Flow:
    a. Operator adjustable set point for High Level Flow.
    b. Increase Well Injection Pump Station flow when selected primary level transducer (LT/LE-26202 or LT/LE-26203) level is > set point.
    c. Decrease (Return) Well Injection Pump Station flow to Baseline when selected primary level transducer (LT/LE-26202 or LT/LE-26203) level is < set point.
6. Lag Injection Well Call:
    a. Operator adjustable set point for calling the Lag Well.
    b. Open Lag Well Valve to Baseline Flow when selected primary level transducer (LT/LE-26202 or LT/LE-26203) level is > set point.
    c. Close Lag Well Valve when selected primary level transducer (LT/LE-26202 or LT/LE-26203) level is < set point.

16.15 Plant Reuse Water Pump Skid

The reuse water system supplies reclaimed water for the headworks fine screen spray wash, Aeration Tank spray nozzles, dilution water for the chemical injection systems, and wash water for general plant maintenance. The reuse water system draws from the Reclaimed Water Tank via the Reuse Water Pump skid. The Reuse Water Pump skid adjusts its pump speed to maintain pressure on the reuse water distribution system.

For operation of the Reuse Water Pump skid:

1. The entire system is controlled by the manufacturer's control panel (WRP CP-263).
2. Operation of the Reuse Water Pumps is disabled when a low-level alarm is active for the Reclaimed Water Tank.
3. The SCADA HMI will display and record various input/output (I/O) status and alarm points from the skid. Pump skid controls will only be available at the skid control panel (CP-263).

16.16 Reclaimed Water Injection Pump Station

16.16.1 Overview

The Injection Wells Pump Station consists of four pumps. These pumps are to operate in a lead/lag1/lag2/Standby fashion. The pumps function to supply Reclaimed Water to the Injection Wells at a constant pressure regardless of the flow demand.

16.16.2 Operation (P-26531, P-26532, P-26533, and P-26534)

With the HOA switch on the VFD operator interface placed in the AUTO position, the three lead/Lag pumps will be controlled automatically by CP-201 based on the Injection Well Supply pressure and the PLC. This will maintain a constant supply pressure to the Injection Wells at the operator adjustable set point. During Continuous Pressure Control mode, the number of pumps operating and the pump speeds are varied by a PID control loop in the PLC to maintain a constant supply pressure. When the pumps are first engaged, the pumps will start at the speed set by the PID controller. The pumps will operate in Continuous Pressure Control mode provided all the following permissives are true:

1. At least one injection well is open.
2. There is no failure in control system.
3. The Reclaimed Water Tank level is above the Low-Low Alarm.

Due to low flow demand during the initial phase of operation, it is expected that typically one to two pumps will be utilized at any given time. To ensure equal use of pumps, the lead pump will alternate on a schedule as determined by the operator. The operator may also choose to select the lead pump manually.

The operator adjustable set points based on the Injection Well Supply pressure transducer are as follows:

1. Injection Pumps Operation Control Pressure (30 – 40 psi).
2. Injection Lag Pumps Start Speed (90 – 96 percent).
3. Injection Lag Pumps Start Speed (60 – 75 percent).

Other settings available to the operator:

1. Auto Alternation On/Off Push Button.
2. Lead Change Push Button.
3. Days and Time for Auto Alternation.

16.17 Injection Wells

16.17.1 Injection Well Operational Summary

Reclaimed water from the Reclaimed Water Tank is pumped to the Injection Wells. In the initial construction phase there are 7 wells located under the Resort parking lot. A total of eleven (11) wells are planned for future reclaimed water disposal. Reclaimed water will be pumped from the Water Reclamation Plant (WRP) by the Well Injection Pumps on pressure control to one or more injection wells as required based in the amount of reclaimed water being produced by the WRP. The quantity of wells in service and the flow rate to those wells will be determined automatically by the WRP PLC control system or manually by the WRP operators.

OPERATOR'S NOTE: The selected Lead well is always open and active to maintain a steady flow to the well.

16.17.2 Injection Well 1 Description

Well 1 is located at the far end of the reclaimed water line, at the west end of the Resort parking lot. It was the original test well and its capacity is less because than the other wells because it only has a 1-1/2 inch injection pipe.

1. The reclaimed water injection flow rate is controlled by an electrically modulated valve that is located in the vault. This valve is fully accessible inside the vault.
2. There are three instruments in the vault for control of reclaimed water injection.
    a. A magnetic flow meter to measure the flow rate of reclaimed water being injected into well. It has an integral display to allow reading the flow rate and flow count while in the vault.
    b. A pressure transmitter on the injection line to read the reclaimed water pressure being supplied to the well. It has an indicator to read the well supply pressure.
    c. A level transmitter that is suspended inside the well casing to read the water level in the well.
3. A flood (level) switch is mounted on the vault wall, designed to provide an alarm should water on the vault floor begin to accumulate to approximately 1 inch.
4. An Intrusion Switch is mounted under the vault cover and will alert the operators anytime the hatch is open.

16.17.3 Injection Wells 2 – 7 Description

1. Wells 2 through 7 will be the primary wells for disposing of reclaimed water from the WRP. Wells 2 through 7 are identical in design and operation. Well 3 has not been equipped.
2. Injected flow is controlled by a hydraulically operated control valve that is mounted on the end of the injection pipe at the bottom of the well. The valve is opened and closed using hydraulic lines that are connected to an electrically operated hydraulic pump package located inside the vault.
3. To open and close the valve, the hydraulic pump must be running and either the open or closed solenoid valve in the hydraulic pack must be energized (opened). Only one solenoid valve may

be energized (opened) at a time. When both solenoid valves are closed (off), hydraulic pressure is sealed in the hydraulic lines and the valve is held in position.

4. There are three instruments in the vault for control of reclaimed water injection.
   a. A magnetic flow meter to measure the flow rate of reclaimed water being injected into the well. It has an integral display to allow reading the flow rate and flow count while in the vault.
   b. A pressure transmitter on the injection line to read the reclaimed water pressure being supplied to the well. It has an indicator to read the well supply pressure.
   c. A level transmitter that is suspended inside the well casing to read the water level in the well.
5. A flood (level) switch is mounted on the vault wall, designed to provide an alarm should water on the vault floor begin to accumulate to approximately 1 inch.
6. An Intrusion Switch is mounted under the vault cover and will alert the operators anytime the hatch is open.

16.17.4 Well Local Controls

1. Controls for the wells are located inside control panels located in the Resort parking lot. Each control panel has a PLC. Multiple control panels are designed to provide operational redundancy should there be an internal component failure or should the panel be physically damaged. Loss of any single control panel will result in loss of only two primary wells.
   a. Well Control Panel CP-261 controls Wells 1, 2 and 5.
   b. Well Control Panel CP-262 controls Well 6. This panel will also control Well 3 if the well is ultimately equipped.
   c. Well Control Panel CP-263 controls Wells 4 and 7.
   d. Future Well Control Panel CP-264 will control Wells 8 and 9.
   e. Future Well Control Panel CP-265 will control Wells 10 and 11.

16.17.5 Automatic Operation

1. The injection flow rate is calculated in the Main Control Panel and individual remote set point signals are sent by telemetry radio to each well injection control panel. The remote set point signal is reduced if the well head pressure begins to drop or if the well level rises above a preset maximum. The well flow controller is the primary controller for injecting water from the Water Reclamation Plant in the well. Using flow control ensures that the injection flow will remain constant regardless of header pressure variations that occur during operation of the other injection well controls.
2. The flow controller has a local/remote set point selector that allows the operator to select between WRP control and local operator control. The remote set point value is sent from the WRP control system. This signal is the same value that is sent to all well flow controllers. The local set point is for controlling the flow rate of its respective well flow controller at the well control panel.

3. The "WRP"/"Local Well" selection can be changed at both the Well PLC Operator Interface Unit (OIU) and from the Main PLC Control Panel at the WRP. The WRP (remote set point) is transmitted from the WRP via the telemetry system and the "Local Well" (internal) set point which can be set by the operator.
   a. "WRP Control":
      (1) The "WRP Control" signal is the controller output from the Reclaimed Water Tank Level Controller. Only wells that are selected to be operating, will respond to this signal. For more information regarding the Reclaimed Water Tank level control, see Section 16.14, Reclaimed Water Tank.
      (2) When a well flow controller is set in "WRP Control," the injection flow rate will vary according to the Reclaimed Water Tank level.
      (3) A "Maximum Allowed Set point" value limits the upper value for flow set point. This maximum is determined at startup and protects the well from internal damage that can be caused by injecting water at a rate that is too high for the well bed.
   b. "Local Control":
      (1) The automatic flow control set point value is a value that an operator enters on the OIU or at the WRP. It ignores the WRP calculated target set point and remains at this setting until changed by the operator.
      (2) The Local set point is also limited by the "Maximum Allowed Set point" value described above.

16.17.6 Pressure and Level Controllers

1. Pressure Control:
   a. The purpose of Pressure control is to ensure a full injection pipe should the Well Supply Pressure drop due to loss of adequate reclaimed water supply pressure.
   b. The Pressure controller subtracts a proportional bias from the Flow Control value causing the valve to close based on supply header pressure.
2. Level Control:
   a. The well level controller reduces the well flow controller output to keep the injection rate from overflowing the well.
   b. The Level controller subtracts a proportional bias from the Flow Control value causing the valve to close based on well level.

16.18 Auxiliary Systems

16.18.1 Plant Influent/Reclaimed Water Automatic Samplers

16.18.1.1 Overview

The WRP influent and reclaimed water are automatically sampled by automated composite refrigerated samplers. The influent sampler is located at the Headworks and samples from the headworks channel. The reclaimed water sampler samples from the reclaimed water line downstream of the UV disinfection and upstream of the CLS injection point. A chlorine analyzer also samples from the reclaimed water line exiting the Reclaimed Water Tank upstream of the Well Injection Pumps. The function of the samplers, physical description, operation, and controls are included in the manufacturer's literature and briefly summarized below:

- Each of the automatic samplers is contained in a refrigerated fiberglass enclosure and consists of the following: vacuum pump, single or multiple sample containers, control valves, and circuitry.
- When the sampler is controlled by the timer, it will sample every time the timer times out. When the timer times out, it automatically resets and begins timing again. Under normal operation, the samplers should be set to operate by the flow meters, except when the flow metering system is malfunctioning or a special plant performance and monitoring study is being performed.

16.18.1.2 Influent Sampler (SMP-20108)

The sampler flow pacing signal from the WRP influent flow rate (FT/FE-20220) is sent via a 4-20 mA signal from CP-210. The influent flow rate signal is scaled to the full range of the flow meter.

16.18.1.3 Reclaimed Water Sampler (SMP-26131)

The sampler flow pacing signal from the WRP permeate flow rate (sum of Kubota permeate flow meters) is sent via 4-20 mA signal from CP-201. The permeate flow rate is scaled to the full range of the summed flow meters.

16.18.1.1 Chlorine Analyzer (SMP-26132)

The sampler flow pacing signal from the reclaimed water flow rate (FT/FE-26540) is sent via a 4-20 mA signal from CP-201. The influent flow rate signal is scaled to the full range of the flow meter.

16.18.2 Operations Building Grinder Pump Station

Drains for the Operations Building discharge into the Grinder Pump Station. The Grinder Pump Station discharges into the influent manhole.

The entire pump station is from one manufacturer and controlled with level sensors integral to each pump/motor assembly. The entire control and configuration is done at the manufacturer's supplied control panel (CP-280).

No controls are operable from the SCADA HMI. Only a general status/alarm is available from CP-280 to the SCADA HMI.

16.18.3 Eyewash/Emergency Showers

Each eyewash/emergency shower has a flow switch to indicate when the system is in use. When the flow switch is activated by flow, an alarm is provided for each individual sensor.

The flow switch input is energized when no-flow and not-energized when there is flow.

16.19 Instrumentation Schedule

Analytic Measurement Devices					
Tag	**Loop No.**	**Service**	**Power Supply**	**Output**	**Calibration Range**
AE/AIT	26541	Reclaim Water CL_2 Residual Level	120 Volts ac (Vac)	4 to 20 mA dc	0 to 5 mg/L

Flow Measurement Devices						
Tag	**Loop No.**	**Service**	**Power Supply**	**Output**		**Calibration Range**
				No. 1	**No. 2**	
FE/FT	21311	Recycle to MBR Inlet Flow	120 Vac	4 to 20 mA dc	N.O. Contact every 20 gal.	0 to 1,000
FE/FT	20303	MBR Influent Flow	120 Vac	4 to 20 mA dc	N.O. Contact every 20 gal.	0 to 1,000
FE/FT	21401	WAS to Storage Flow	120 Vac	4 to 20 mA dc	N.O. Contact	0 to 200
FE/FT	26540	Injection Well Reclaimed Water Supply Flow	120 Vac	4 to 20 mA dc	N.O. Contact every 20 gal.	0 to 400
FE/FT	26310	Reuse Water Flow	120 Vac	4 to 20 mA dc	N.O. Contact every 5 gal.	0 to 200
FE/FT	27801	WAS Truck Loading from Storage	120 Vac	4 to 20 mA dc	N.O. Contact every 5 gal.	0 to 250
FE/FT	20220	Influent Flow (Parshall Flume)	120 Vac	4 to 20 mA dc	N.O. Contact every 20 gal.	0 to 1,000
FE/FT	26611	Injection Well 1 Flow	120 Vac	4 to 20 mA dc	N.O. Contact every 500 gal.	0 to 400
FE/FT	26621	Injection Well 2 Flow	120 Vac	4 to 20 mA dc	N.O. Contact every 500 gal.	0 to 400
FE/FT	26631	Injection Well 3 Flow (not installed)	120 Vac	4 to 20 mA dc	N.O. Contact every 500 gal.	0 to 400
FE/FT	26641	Injection Well 4 Flow	120 Vac	4 to 20 mA dc	N.O. Contact every 500 gal.	0 to 400
FE/FT	26651	Injection Well 5 Flow	120 Vac	4 to 20 mA dc	N.O. Contact every 500 gal.	0 to 400
FE/FT	26661	Injection Well 6 Flow	120 Vac	4 to 20 mA dc	N.O. Contact every 500 gal.	0 to 400
FE/FT	26671	Injection Well 7 Flow	120 Vac	4 to 20 mA dc	N.O. Contact every 500 gal.	0 to 400
Note: Verify meter size with mechanical drawings.						

Flow Switch Devices					
Tag	**Loop No.**	**Service**	**Power Supply**	**Output**	**Calibration Range**
FSH	29001	Lab Eye Wash/Safety Shower High Flow	120 Vac	N.O. Contact	0 to 0.05 increase gpm
FSH	29002	Mechanical Room Eye Wash/Safety Shower High Flow	120 Vac	N.O. Contact	0 to 0.05 increase gpm

Pressure Measurement Devices			
Tag	**Loop No.**	**Service**	**Display Range**
PT	26310	Reuse Water Pressure	24 Volts direct current (Vdc)
PT	26530	Injection Well Supply Pressure	24 Vdc
PT	26612	Injection Well 1 Pressure	24 Vdc
PT	26622	Injection Well 2 Pressure	24 Vdc
PT	26632	Injection Well 3 Pressure (not installed)	24 Vdc
PT	26642	Injection Well 4 Pressure	24 Vdc
PT	26652	Injection Well 5 Pressure	24 Vdc
PT	26662	Injection Well 6 Pressure	24 Vdc
PT	26672	Injection Well 7 Pressure	24 Vdc
PI	20301	Influent Pump 1 Outlet Pressure	0 to 100 psig
PI	20302	Influent Pump 2 Outlet Pressure	0 to 100 psig
PI	20303	Influent Pump 3 Outlet Pressure	0 to 100 psig
PI	21111	Feed Forward Pump 1 Outlet Pressure	0 to 100 psig
PI	21112	Feed Forward Pump 2 Outlet Pressure	0 to 100 psig
PI	21113	Feed Forward Pump 3 Outlet Pressure	0 to 100 psig
PI	26310	Reuse Water Header Pressure	0 to 100 psig
PI	26501	Reuse Water Pressure Tank Pressure	0 to 100 psig
PI	27801	WAS Feed Pump Pressure	0 to 100 psig
PI	29021	CLS Pump 1 Pressure	0 to 100 psig
PI	29022	CLS Pump 2 Pressure	0 to 100 psig
PI	29041	$MgOH_2$ Pump 1 Pressure	0 to 100 psig
PI	29042	$MgOH_2$ Pump 2 Pressure	0 to 100 psig

Level Measurement Devices					
Tag	**Loop No.**	**Service**	**Power Supply**	**Output**	**Calibration Range (in H_2O)**
LT	20111	Fine Screen 1 Inlet Level	24 Vdc	4 to 40 mA dc	0 to 40”
LT	20121	Fine Screen 2 Inlet Level	24 Vdc	4 to 40 mA dc	0 to 40”
LT	20122	Fine Screen 1&2 Outlet Level	24 Vdc	4 to 40 mA dc	0 to 40”
LT	20301	Pump Station Wet Well Level Transmitter A	24 Vdc	4 to 40 mA dc	0 to 23’
LT	20302	Pump Station Wet Well Level Transmitter B	24 Vdc	4 to 40 mA dc	0 to 23’
LT	26202	Reclaim Water Tank Level Transmitter A	24 Vdc	4 to 40 mA dc	0 to 35’
LT	26203	Reclaim Water Tank Level Transmitter B	24 Vdc	4 to 40 mA dc	0 to 35’
LT	27803	Solids Tank Level	24 Vdc	4 to 40 mA dc	
LT	29031	$MgOH_2$ Tank Level	24 Vdc	4 to 40 mA dc	
LT	26613	Injection Well 1 Level	24 Vdc	4 to 40 mA dc	
LT	26623	Injection Well 2 Level	24 Vdc	4 to 40 mA dc	
LT	26633	Injection Well 3 Level (not installed)	24 Vdc	4 to 40 mA dc	
LT	26643	Injection Well 4 Level	24 Vdc	4 to 40 mA dc	

Level Measurement Devices (Continued)					
Tag	**Loop No.**	**Service**	**Power Supply**	**Output**	**Calibration Range (in H_2O)**
LT	26653	Injection Well 5 Level	24 Vdc	4 to 40 mA dc	
LT	26663	Injection Well 6 Level	24 Vdc	4 to 40 mA dc	
LT	26673	Injection Well 7 Level	24 Vdc	4 to 40 mA dc	
LS	26614	Injection Well 1 Vault Level (Flood)	24 Vdc	N.C. Contact	
LS	26624	Injection Well 2 Vault Level (Flood)	24 Vdc	N.C. Contact	
LS	26634	Injection Well 3 Vault Level (Flood) (not installed)	24 Vdc	N.C. Contact	
LS	26644	Injection Well 4 Vault Level (Flood)	24 Vdc	N.C. Contact	
LS	26654	Injection Well 5 Vault Level (Flood)	24 Vdc	N.C. Contact	
LS	26664	Injection Well 6 Vault Level (Flood)	24 Vdc	N.C. Contact	
LS	26674	Injection Well 7 Vault Level (Flood)	24 Vdc	N.C. Contact	
LSL	20300	Pump Station Wet Well Level Low-Low	Intrinsic Relay Supplied	N.O. Contact	33 inch decrease
LSH	20300	Pump Station Wet Well Level High	Intrinsic Relay Supplied	N.O. Contact	96 inch increase
LSH	20301	Influent Wet Well Level High Pump 1 Backup	Intrinsic Relay Supplied	N.O. Contact	92 inches increasing level
LSH	20302	Influent Wet Well Level High Pump 2 Backup	Intrinsic Relay Supplied	N.O. Contact	88 inches increasing level
LSH	20303	Influent Wet Well Level High Pump 3 Backup	Intrinsic Relay Supplied	N.O. Contact	84 inches increasing level
LSLL	26201	Reclaim Water Tank Level Low-Low	120 Vac	N.O. Contact	
LSL	26201	Reclaimed Water Tank Level Low	120 Vac	N.O. Contact	
LSH	26201	Reclaimed Water Tank Level High	120 Vac	N.O. Contact	
LSLL	27805	Solids Tank Level Low-Low	120 Vac	N.O. Contact	36 inch decrease
LSH	27805	Solids Tank Level High	120 Vac	N.O. Contact	164 inch increase
LSLL	29011	CLS Day Tank Level Low-Low	120 Vac	N.O. Contact	10% decrease
LSL	29011	CLS Day Tank Level Low	120 Vac	N.O. Contact	20% decrease
LSH	29011	CLS Day Tank Level High	120 Vac	N.O. Contact	90% increase
NOTE: Level transmitter calibrations are set with 0 equal to the bottom of the vessel, trough or tank and full scale equal to the calibration range in inches of water above the bottom surface. N.C. refers to Normally Closed and N.O. refers to Normally Open					

Process Switches				
Tag	**Loop No.**	**Service**	**Power Supply**	**Output**
ZS	20202A	Intrusion Switch: Influent Pump Station Wet Well Hatch	24 Vdc	N.O. Contact
ZS	20202B	Intrusion Switch: Influent Pump Station Wet Well Hatch	24 Vdc	N.O. Contact
ZS	20202C	Intrusion Switch: Influent Pump Station Wet Well Hatch	24 Vdc	N.O. Contact
ZS	20302D	Intrusion Switch: Influent Valve Vault Hatch	24 Vdc	N.O. Contact
ZS	20100A	Intrusion Switch: OPS Building Electrical Room East Door	24 Vdc	N.O. Contact
ZS	20100B	Intrusion Switch: OPS Building Mechanical Room North Door	24 Vdc	N.O. Contact
ZS	20100C	Intrusion Switch: OPS Building Mechanical Room Overhead Door	24 Vdc	N.O. Contact
ZS	20100D	Intrusion Switch: OPS Building Electrical Room West Door	24 Vdc	N.O. Contact
ZS	20301A	Intrusion Switch: OPS Building MBR Utilidor	24 Vdc	N.O. Contact
ZS	20301B	Intrusion Switch: OPS Building MBR Utilidor	24 Vdc	N.O. Contact
ZS	20301C	Intrusion Switch: OPS Building Entry Door	24 Vdc	N.O. Contact
ZS	20301D	Intrusion Switch: OPS Building Upper Level/MBR Tank Door	24 Vdc	N.O. Contact
ZS	21000A	Intrusion Switch: HW Building Electrical Room Door	24 Vdc	N.O. Contact
ZS	26201A	Intrusion Switch: Reclaim Tank Hatch	24 Vdc	N.O. Contact
ZS	26201B	Intrusion Switch: Reclaim Tank Hatch	24 Vdc	N.O. Contact
ZS	26615	Intrusion Switch: Injection Well 1 Vault	24 Vdc	N.O. Contact
ZS	26625	Intrusion Switch: Injection Well 2 Vault	24 Vdc	N.O. Contact
ZS	26635	Intrusion Switch: Injection Well 3 Vault	24 Vdc	N.O. Contact
ZS	26645	Intrusion Switch: Injection Well 4 Vault	24 Vdc	N.O. Contact
ZS	26655	Intrusion Switch: Injection Well 5 Vault	24 Vdc	N.O. Contact
ZS	26665	Intrusion Switch: Injection Well 6 Vault	24 Vdc	N.O. Contact
ZS	26675	Intrusion Switch: Injection Well 7 Vault	24 Vdc	N.O. Contact
ZS		Intrusion Switch: CP-261 Panel	24 Vdc	N.O. Contact
ZS		Intrusion Switch: CP-262 Panel	24 Vdc	N.O. Contact
ZS		Intrusion Switch: CP-263 Panel	24 Vdc	N.O. Contact

17. SITE UTILITIES

This section provides a summary of the WRP site utilities including electrical, communications, and potable water.

17.1 Electrical Distribution

17.1.1 Overview

Refer to Sheets E10, E11, E13, and E15 of the Record Drawings for the WRP power one-line diagrams.

The electrical power for the treatment plant is provided by Clark Public Utilities (CPU). The CPU system is tapped at a power pole on NW 31st Avenue near the southwest corner of the WRP site.

Power to the WRP is fed from the pole to the CPU transformer, and routed underground across the service road to the Electrical Room in the Operations Building. Power for the site is distributed through the Operations Building to the Headworks Building. A standby generator provides backup power during electrical utility interruptions.

SAFETY NOTE! Testing of electrical equipment must be done by qualified electrical personnel only. Always follow approved lockout/tag out procedures (Appendix F) prior to servicing electrical equipment. Improper servicing could result in serious injury or death.

17.1.2 Utility Transformer

The WRP utility transformer (see Figure 17-1) is located on the west side of the WRP site, across the service road from the Operations Building and adjacent to the parking area. It is owned and maintained by CPU. The transformer reduces the utility's 12.47 kiloVolt (kV) medium voltage to the 480 V secondary voltage required for the WRP. Power from the transformer is fed to the main switchgear (SWBD-200) in the Operations Building.

Sizing has been calculated to accommodate the planned future expansion of the WRP.

Figure 17-1. Utility Transformer

17.1.3 WRP Power Distribution

Power from the CPU transformer enters the Electrical Room in the Operations Building and is terminated in SWBD-200, which includes the Current Transformer Metering Enclosure (ME-200). From ME-200, the service is routed through the primary main breaker automatic transfer switch (ATS-200). Standby power is provided by an on-site generator and terminated in the backup side of ATS-200. Power is then distributed to the circuit breakers, variable frequency drives (VFDs), and motor controllers located in the Operations Motor Control Centers MCC-201 and MCC-202. Headworks Motor Control Centers MCC-203 and MCC-204 are fed from the main switchboard (SWBD-200). A surge protection device is also included in SWBD-200. SWBD-200 is depicted in Figure 17-2.

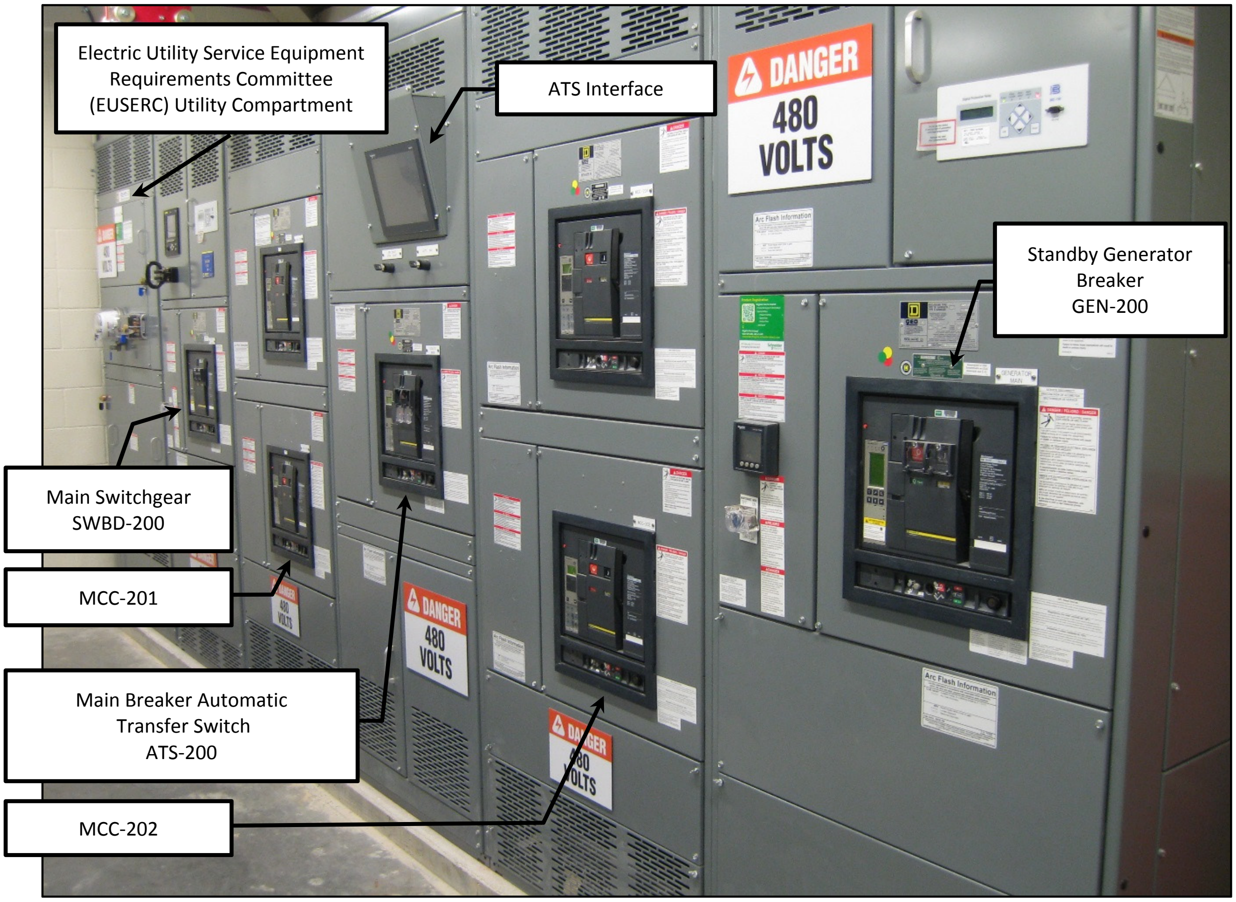

Figure 17-2. SWBD-200

17.1.4 Service Disconnect Switch (MAIN 52A)

The incoming power disconnect is located on the southwest wall of the Operations Building Electrical Room as part of SWBD-200. The main disconnect is a 1200 ampere (A) frame breaker with a 1200 A trip.

OPERATOR'S NOTE: Operating the 1200 A circuit breaker (Figure 17-3) will isolate the entire WRP power system from the CPU feed and will cause the station generator to start automatically.

Figure 17-3. SWBD-200 Breaker

17.1.5 Automatic Transfer Switch

The Square D automatic transfer switch (ATS) interface (Figure 17-4) is located in Section 3 of MCC-201. Power from both the CPU and the generator enters ATS-200. A controller in the ATS continuously checks the CPU utility voltage and, on loss of utility voltage, sends a command to start the generator.

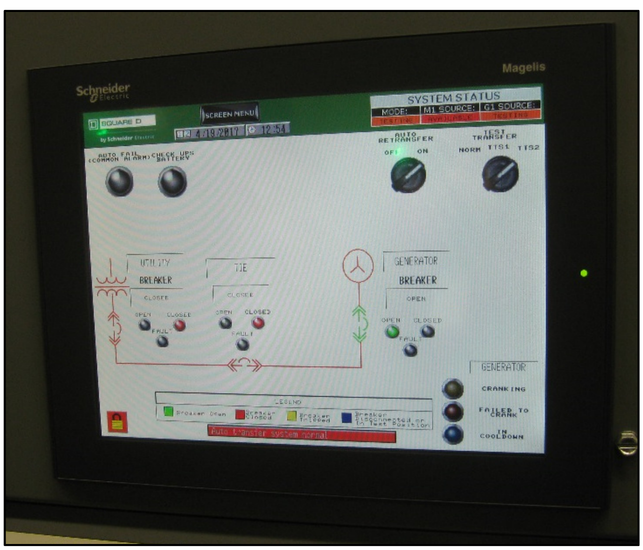

Figure 17-4. WRP ATS Interface

Once the generator starts and it is operating at station voltage (480 V) and frequency (60 Hz), the ATS switches to generator, sending power from the generator to MCC-201 and MCC-202.

The ATS continues to monitor the CPU voltage; once the voltage has returned to normal for at least 10 seconds, the ATS automatically transfers back to CPU power. The generator then runs for 15 minutes to cool down and then shuts off.

In the event of failure of the ATS, it can be manually operated to restore generator power to the station. Refer to the manufacturer's instructions or call the manufacturer's service representative for safety and operating instructions.

The ATS also controls periodic exercising of the diesel engine generator system. The default program will automatically start the generator at 1:00 p.m. on Sundays. After 30 minutes, the ATS will send a stop signal and allow the generator to begin the 15-minute cool down period. The ATS can be programmed to transfer the WRP load onto generator power.

MAINTENANCE NOTE: The generator should be run at least once a month.

17.1.6 Standby Generator

The standby generator is a Kohler standby power packaged diesel engine generator set (Figure 17-5) rated at 650 kilowatt (kW). It provides power to operate all site power requirements at buildout in the event of a failure of utility power.

Figure 17-5. WRP Standby Generator

The capacity of the generator is large enough to operate all of the WRP site loads for approximately 24 hours, based on the load steps found in the approved manufacturer's technical submittal data.

The generator enclosure contains a local control panel that provides controls and indications of alarms for the generator. The enclosure also contains a 1000 A circuit breaker for protecting the conductors between the generator and automatic transfer switch.

The process control system monitors several pieces of information from the generator and ATS system, which include:

- Running.
- Warning Alarm.
- Shutdown Alarm.
- Day Tank Leak.
- Main Fuel Tank Leak.
- Day Tank Fuel Low Level.
- Main Tank Fuel Low Level.
- Generator Not In Auto.
- Generator Intrusion Alarm.

These items are used by the process control system to determine how the backup power system is operating, and the control system will notify plant operators in the event of an alarm or failure.

Figure 17-6. Load Bank Terminal Cabinet

OPERATOR'S NOTE: If the generator fails to start, or is operating but not producing power, confirm that the generator circuit breaker has not tripped.

The generator is equipped with a 1038-gallon sub-base fuel tank providing approximately 24-hour fuel supply at full load.

The load bank terminal cabinet provides an accessible location for connecting a resistive load when testing the generator (Figure 17-6).

MAINTENANCE NOTE: A load bank will need to be rented to test the generator under full load annually. Follow manufacturer's requirements.

17.1.7 Motor Control Center Centers (MCCs)

The Operations MCCs are located in the Operations Building Electrical Room (Figure 17-7 through Figure 17-10 on the following page). Power to the MCCs comes from ATS-200. In the second section of both MCCs is a power monitor display. It can monitor many parameters including voltage, current, frequency, and real and reactive power.

These MCCs contain the 277/480 V breakers, motor starters, and VFDs for the Operations Building. MCC-201 also contains the site lighting control. There are empty locations for spare starters and spare VFDs for future equipment as identified in the MCC One-Line Diagrams. The main switchboard (SWBD-200) feeds power to Headworks MCC-203 and MCC-204.

Figure 17-7. MCC-201

Figure 17-8. MCC-201

Figure 17-9. MCC-202

Figure 17-10. MCC-202

The Headworks MCCs are located side-by-side in the Headworks Electrical Room. There is a tie breaker allowing both MCC-203 and MCC-204 to be fed from an individual source. This allows maintenance shutdown of either operations MCC without power loss to the headworks. A Kirk-Key interlock system is in place to prevent closing of both source breakers when the tie breaker is closed.

MCC-203 and MCC-204 contain the 277/480 V breakers, motor starters, and VFDs for the Headworks Building and influent pumping, with future space for odor control. MCC-203 also contains the 120/208 V lighting panel (LP-204).

17.2 COMMUNICATIONS

Telephone service is provided by Comcast Xfinity. One 25-pair service entry cable with five standard voice grade private line circuits is provided. Two voice circuits are used for the fire alarm system callout and one dedicated circuit is used for the control system autodialer callout. Broadband internet service is provided by Comcast Xfinity. Fiber optic cable enters the WRP along the main driveway and is terminated in cabinet NE-201 located in the Operations Building Electrical Room.

SAFETY NOTE! Do not dig at the site based on construction documents. Always obtain underground utility locates before digging.

17.3 Potable Water

Potable water service is provided by CPU. An 8-inch water main is looped through the site as shown on Sheets C9 and C10 of the Record Drawings. The metered potable water service enters the Operations Building through a 2-inch service line located on the south side of the Injection Pump Room.

18. SAMPLING AND LABORATORY PROCEDURES

18.1 INTRODUCTION

This section outlines influent, reclaimed water, and process parameter sampling techniques and laboratory analytical procedures critical to:

- Provide data essential for facility control and maximization of operational efficiency.
- Maintain historical records on facility performance.
- Verification of EPA Rule Authorization compliance.

There are two good references to have at the WRP for details on all sampling procedures and handling: *Standard Methods for the Examination of Water and Wastewater* and Water Environment Federation's (WEF's) *Wastewater Sampling for Process and Quality Control* (MOP OM-1).

18.1.1 Sampling Schedule

Table 18-1 and Table 18-2 summarize recommended facility testing requirements for influent and reclaimed water, respectively. Table 18-3 summarizes facility testing requirements to verify that reclaimed water is meeting the requirements of the EPA Rule Authorization further described in Chapter 2.

Table 18-1. Influent Sampling Schedule

Parameter	Units	Minimum Sampling Frequency	Sample Type
Flow	mgd	Continuous[a]	Recording meter
BOD_5	mg/L pounds/day	Weekly	24-hour composite
TSS	mg/L pounds/day	Weekly	24-hour composite
pH	Standard Units	Daily (when operator is present)	Grab

[a] Continuous means uninterrupted except for brief lengths of time for calibration, for power failure, or for unanticipated equipment repair or maintenance. Sampling shall be taken every 4 hours when continuous monitoring is not possible.

Table 18-2. Reclaimed Water Sampling Schedule

Parameter	Units	Sampling Point[a]	Minimum Sampling Frequency	Sample Type
Flow	mgd	Disinfected Permeate Water	Continuous	Recording meter
BOD_5	mg/L	Disinfected Permeate Water	Weekly	24-hour composite
BOD_5	pounds/day	Disinfected Permeate Water	Weekly	Calculation
BOD_5	percent removal	Disinfected Permeate Water	Weekly	Calculation
TSS	mg/L	Disinfected Permeate Water	Weekly	24-hour composite
TSS	pounds/day	Disinfected Permeate Water	Weekly	Calculation
TSS	percent removal	Disinfected Permeate Water	Weekly	Calculation

(Table Continues)

Table 18-2. Reclaimed Water Sampling Schedule (Continued)

Parameter	Units	Sampling Point[a]	Minimum Sampling Frequency	Sample Type
pH	Standard Units	Disinfected Permeate Water	Daily	Grab[b]
TOC	mg/L	Disinfected Permeate Water	Weekly (recommended by EPA)	24-hour composite
Temperature	Celsius	Disinfected Permeate Water	Daily	Grab[b]
Turbidity	Nephelometric Turbidity Units (NTU)	Permeate Water before Disinfection	Continuous[c]	Recording meter
Total Nitrogen (as N)	mg/L	Disinfected Permeate Water	Monthly	24-hour composite
Ammonia (as N)	mg/L	Disinfected Permeate Water	Weekly	24-hour composite
Nitrate (as N)	mg/L		Weekly	24-hour composite
Total Coliform[d]	No. of org. per 100 ml	Disinfected Permeate Water	Daily	Grab[b]
Federal Primary Drinking Water Standard Listed in Appendix A	See Appendix A	Post UV Disinfection	Quarterly first year of operation Semiannual following first year	24-hour composite[e]
Free Chlorine Residual	mg/L	Post Reclaimed Water Storage Tank	Daily (when in use)	Grab[a]
Free Chlorine Residual	mg/L	Active Monitoring Well(s) at well head	Weekly (when in use)	Grab[a]
Free Chlorine Residual	mg/L	Plant Reclaimed Water	Daily (when in use)	Grab[b]

a Disinfected permeate water samples shall be taken from 8-inch reclaimed water pipe. Daily grab samples will only be taken on days that the operators are present at the WRP site.

b Grab samples shall be taken at the same time daily when wastewater characteristics are the most demanding on the treatment facilities and disinfection processes. Daily grab samples will only be taken on days that the operators are present at the WRP site.

c Reclaimed water turbidity analysis shall be performed by a continuous recording turbidimeter and shall also be read and recorded at least once per day.

d As an alternate method, total coliform bacteria may be monitored using the ONPUG-MUG test (also called Autoanalysis Colilert System)

e Testing for Primary Drinking Water Standards shall be completed using the most current accepted EPA sampling and testing protocols.

Table 18-3. EPA Rule Authorization Sampling Schedule

Parameter	Units	Sampling Point[a]	Minimum Sampling Frequency	Sample Type
Federal Primary Drinking Water Standard Listed in Appendix A	See Appendix A	Monitoring Well, Injection Site	Semiannual first 2 years of operation Annual following second year	EPA Low Stress (Low Flow) Sampling Protocol
Federal Primary Drinking Water Standard Listed in Appendix A	See Appendix A	Monitoring Well, North Side of Reservation	Annual following third year of operation	EPA Low Stress (Low Flow) Sampling Protocol

a Groundwater Samples will be taken from monitoring wells using the most current accepted EPA Protocol for groundwater sampling and testing under the UIC Program. Testing for Primary Drinking Water Standards shall be completed using the most current accepted EPA sampling and testing protocols.

18.1.2 Process Control Monitoring for Membrane System

The MBR system and individual system components are discussed in detail in Chapter 9. Operational monitoring protocols are required to determine the efficiency of the MBR treatment system and to control specific loading conditions.

Table 18-4 is a partial list of suggested parameters and sampling frequency recommended in the O&M manual that was provided by Kubota Membranes of America, Inc. (Kubota Table 1.3-2).

Table 18-4. MBR Recommended Operational Monitoring Requirements

Parameter[a]	Recommended Monitoring Frequency[a]	Sample Location[b] IN/EFF/MBR[c]
Permeate Flow	1/min	EFF
Air Scour Flow	1/min	MBR
Mixed Liquor TSS	2/week	MBR
Water Temperature	1/day	MBR
TMP	1/min	MBR
pH	2/week	IN/EFF/MBR
DO	1/day	MBR
Filterability	1/day	MBR
Turbidity	1/week	EFF
Ammonia-Nitrogen (NH_3-N)	1/week	IN/EFF

a Parameter type and testing frequency assume typical municipal waste. For industrial applications or other, requirements can change.

b IN/EFF/MBR refer respectively to; influent wastewater downstream of screening, permeate downstream of SMUs only (not post disinfection), and mixed liquor inside the MBR.

c Collect 24-hour composite samples for influent and reclaimed water testing. For mixed liquor lab samples, simply submerge a container directly into the MBR. Follow sampling protocol as required for lab analysis of DO.

It would also greatly benefit the operators to maintain a history of influent nitrogen loads to the facility (total nitrogen [TN], TKN, nitrates, etc.) to evaluate nitrogen removal and remaining removal capacity of the system.

18.1.3 Sampling Procedures

The following steps should be followed by the WRP staff to obtain quality and representative samples:

- Samples collected on a routine basis should be taken from the same location at the same time of day or week using the same procedures.
- Samples should be taken at locations where the wastewater is as completely mixed as possible.
- When sampling, particles larger than 1/4 inch, floating materials and debris should be excluded, or removed.
- In situations where the interval between sample collection and analysis is long enough to produce changes in concentration or physical states of constituents to be analyzed, preservation techniques such as refrigeration or immersion in ice water should be utilized.

- All sampling equipment such as bottles, automatic samplers, and other collection devices should be properly cleaned and maintained.
- When testing influent and reclaimed water samples, the relationship between the WRP's flow variation and detention time should be considered so that analyses are performed on samples taken from the same waste. This primarily applies to grab samples.
- When utilizing automatic samplers, make sure that sampling personnel understand intake placement, power requirements, and timer/volume adjustments.
- No samples should be taken when there are unusual return flow conditions (i.e., dewatering of a structure) unless the operator is specifically trying to determine the effect of the recycle stream.
- Make sure the automatic sampler's purge cycle is of sufficient duration to completely evacuate the intake line before each sampling cycle.

18.1.4 Sample Handling

Collect enough samples in a suitable container. Error can result from attempting to collect small portions for a composite sample. A minimum sample should be at least 100 milliliters (ml) and a sample containing any unusual particles should be rejected.

Always mix the sample before removing a sub-sample for analysis. If this operation is neglected, the liquid removed will not represent the original. Mixing may be accomplished by shaking, stirring, or other means, depending on the analysis to be conducted and the judgment of the analyst. Careful stirring to avoid aerating the sample is suitable for a BOD test, whereas shaking is fine for a solids determination.

When removing a measured portion of sample, use the appropriate method. For example, if a portion of 50 or 100 ml is desired for a test such as suspended solids, use a graduated cylinder or volumetric flask. The sample should be thoroughly mixed and rapidly poured into the measuring device. It is preferable to miss the exact amount by a small degree rather than to use extreme care in pouring. Extreme care in pouring allows time for the particles in suspension to settle, resulting in error. In a test, such as a total solids or suspended solids in wastewater, the cylinder or flask can be rinsed with distilled water and the rinsings added to the evaporating dish or crucible without adversely affecting the results.

Smaller portions which might be used for BOD tests can be measured with a pipette. However, a fine-tipped pipette can cause error by straining out larger particles. If the opening is sufficiently large, the pipette can be filled by dipping into the container of mixed sample, eliminating the need for using a pipette bulb. Only one portion should be pipetted at a time, as the delay in dispensing more than one portion from the same pipette allows the contents to separate in the pipette.

Preserve the sample during any delay before analysis. For routine wastewater tests, refrigeration is adequate. The temperature should be 4 degrees C (30 degrees F). With a thermometer inserted through the stopper of a refrigerated bottle of water, the temperature can be read without the rapid change that results from opening a refrigerator and reading an unprotected thermometer.

18.1.5 Sampling Methods

There are two different types of plant sampling methods. One method is grab sampling, which consists of a single sample generally taken randomly at no set time or flow. The other is a composite sample which is made up of smaller samples collected at set times or flows during a given period. Both grab and composite samples can be collected either by hand or automated sampler, although composite samples are more representative when collected via an automated sampler.

Composite or integrated samples are collected when a measure of the average quality or condition in the WRP streams is sought. Composite sampling covers a period usually no longer than 24 hours and is commonly conducted for routine analyses of solids, BOD, etc. Ideally, a continuous sample should be taken with volumes at all times in proportion to rate of flow for the waste stream of interest. This capability is provided by automatic influent and reclaimed water samplers. Where this is not practical, samples taken hourly and composited may give reasonably accurate results. Greater frequency may be required where sudden changes occur causing wide variations in wastewater composition and flow.

Where samples are collected during a period less than 24 hours (during an operator shift), a relationship between the results found during the shorter period and the daily average should be established. A factor representing this relationship should thereafter be applied to compute daily volumes.

Satisfactory results are also obtained by collecting a portion of uniform size each time a predetermined amount of flow has passed the sampling station. Using this scheme, samples are collected more often during high flows and less often during low flows.

Groundwater samples will be taken from monitoring wells using the most current accepted EPA Protocol for groundwater sampling and testing under the UIC Program. Due to variability of accepted sampling protocols across different EPA regions, the Tribe should agree upon an appropriate sampling protocol with EPA Region 10 and include that protocol in an appendix to this Manual. Sampling and testing for primary drinking water standards shall be completed using the most current EPA protocols.

18.1.6 Sampling Equipment

18.1.6.1 Sampling Containers

For grab sampling, well-cleaned and rinsed large-mouth glass or plastic containers should be used. It is important that these containers are used for sampling purposes only.

All sampling containers should be well cleaned, then rinsed with the waste being sampled several times. It should be noted that the fecal coliform test requires sterilized containers to preclude the possibility of background contamination of samples. Sterilization can be accomplished by either heating glass containers without their lid in an oven at 350 degrees Fahrenheit (F) or 121 degrees Celsius (C) for 2 hours or by the use of the autoclave (use only glass containers for fecal coliform sampling or autoclaved plastic containers). After the containers have been sterilized, the lids must be put back on tightly as soon as the glass containers and lids are removed from the oven and allowed to cool slightly.

18.1.7 Sample Preservation

All samples must be properly preserved according to the analysis to be performed. Failure to treat samples properly will result in errors. Preservation techniques retard chemical and biological changes, which occur after sample collection. Methods of preservation are intended to:

- Retard biological growth.
- Retard hydrolysis of chemical compounds and complexes.
- Reduce the volatile nature of some chemical constituents.
- Reduce absorption effects, such as ion exchange between complexes.

Preservation methods are generally limited to pH control, chemical fixing, and refrigeration or freezing. Refrigeration at a temperature of 3 to 4 degrees C has been shown to be the most effective method of preservation for both BOD and TSS samples. Dissolved oxygen, chlorine (Cl_2) residual, and pH samples should be prepared and analyzed in-situ or immediately after sample collection. Dissolved oxygen measurements are particularly sensitive to temperature fluctuations and should be conducted at the source. Dissolved oxygen solubility decreases with increasing temperature; therefore, a DO sample analyzed in a relatively warm lab would tend to underestimate DO concentration in the original sample.

18.1.8 Sample Recording

It is important that an accurate record be kept for each sample collected, and that every bottle is clearly labeled and tracked. Sampling records should contain the following where applicable:

- Name of the sample collector.
- Date and time of sample collection.
- Name of the sample analyzer.
- Date and time of sample analysis.
- Type(s) of analysis conducted.
- The exact location and nature of the sample.
- Water temperature (if applicable).
- Other applicable data such as flow at time of sampling.
- Weather conditions.
- Preservation technique, if applicable.
- Analytical technique or method.

Maintenance of accurate daily records used in the operation of the treatment facility will provide the framework for the required monthly reports. Good records are also necessary for process troubleshooting. In addition, it is recommended that weather conditions such as temperature, rainfall, and other hydrological data, along with wastewater physical characteristics such as temperature and pH, be recorded on a daily basis.

18.1.9 Record Keeping

It is recommended that the Tribe retain records of all monitoring information for a minimum of 3 years. Such information must include all calibration and maintenance records and all original recordings for continuous monitoring instrumentation, copies of all reports, and records of all data. All laboratory reports providing data for organic and metal parameters must include the following information: sampling date, sample location, date of analysis, parameter name, Chemical Abstracts Service (CAS) number, analytical method/number, method detection limit (MDL), laboratory practical quantitation limit (PQL) , reporting units, and concentration detected. Analytical results from samples sent to a contract laboratory must include information on the chain of custody, the analytical method, quality assurance/quality control (QA/QC) results, and documentation of accreditation for the parameter.

OPERATOR'S NOTE: It is the recommendation of this manual to collect and store all data in an electronic database indefinitely. This will serve as a reference that could help diagnose process-related issues and educate new operators on the historic function of the facility under various conditions.

19. SAFETY

19.1 Introduction

Safety is an extremely important part of the WRP operation and maintenance. Many potential hazards exist at the facility which employees are exposed to on a routine basis. Hazards may result in injuries if safety procedures are not emphasized and unsafe conditions are not actively eliminated.

In many cases, there will only be a single operator present at the WRP. The operator should plan ahead so that scheduled maintenance tasks, such as entering confined spaces or servicing electrical equipment, are performed when there are two or more operators present.

First aid equipment has been provided at the WRP and should be properly maintained. WRP personnel should know where it is located and how to use it. It is strongly recommended that WRP personnel be required to obtain either Industrial First Aid or Advanced Red Cross First Aid Certification as part of their training. Foremost is the operation and maintenance of a safe work environment to eliminate the necessity of first aid response. General first aid techniques are covered in Chapter 20, Emergency Plans and Procedures.

It is recommended that the Tribe reference the Occupational Safety and Health Act of 1970 which includes general standards common to many industries and is specified in the Safety Code of Federal Regulations Title 29, Part 1910. The phone numbers of some important agencies that can provide additional safety information and support are listed in Table 20-1.

19.2 General Safety Precautions

19.2.1 Confined Space Entry

It is recommended that confined space entry be conducted by Occupational Safety and Health Administration (OSHA)-certified personnel only in accordance with the confined space entry procedures outlined in the Washington State Department of Labor and Industries procedures.

The Tribe is responsible for procedures, training, and planning for entry into confined spaces with toxicity, flammability, oxygen excess or deficiency, mechanical, electrical, corrosive, or temperature hazards.

For each project or job, individuals who are competent in the evaluation of hazards, precautions, first aid, and artificial respiration should be specifically assigned.

19.2.2 Lock-Out/Tag-Out Procedures

Lock-out/tag-out (LOTO) procedures for servicing electrical, mechanical, hydraulic, or otherwise hazardous equipment should be implemented any time a piece of equipment is going to be worked on which could start either by hand or automatically, or which poses the danger of electrocution.

SAFETY NOTE! Proper lock-out/tag-out procedures will prevent accidental injury or death during routine maintenance and repair work. The ilani Resort LOTO procedure is included in Appendix F of this manual.

LOTO procedures should be reviewed, and a copy of the procedure posted in the Operations Building. It is paramount, at a minimum, the following rules are adhered to:

- When possible, lock out electrical sources at local and remote disconnects.
- The person who initiates the action should place their lock-out hasp, lock, and signed tag on the appropriate electrical disconnect.
- All other persons who are working in the area (hands on) should place their locks on the existing lock-out hasp.
- When the task is completed, the last person to remove their lock should be the originator of the action, and that person is the only person authorized to place the equipment back in service.

19.2.3 Sewers

Dangerous sewer gases (e.g. hydrogen sulfide and methane) may accumulate in sewers, manholes, and pump stations as a result of fermentation or decomposition of organic matter. In addition, natural gas from utility main leaks can sometimes enter municipal sewers, as well as accidental spills or illegal dumping of volatile materials such as gasoline, solvents, etc. It is essential that confined space entry procedures be followed when entering manholes.

Manhole steps are often slippery or corroded, increasing the risk of a fall. The following safety precautions, at a minimum, should be observed when climbing down into a manhole:

- Two operators should be present at all manhole sites, although only one operator should enter at a time.
- Before entering a manhole or pump station, normal precautions include use of a combustion gas indicator, an oxygen deficiency indicator, and a portable non-sparking blower to force fresh air into the enclosure.
- Illumination should be provided with an electric explosion-proof lantern.
- A safety harness should be worn when entering a manhole or pump station. Under no circumstances should both people at the site enter a manhole at the same time. If a rescue becomes necessary, the person at the surface should go for help rather than entering the manhole.

Table 19-1 on the following page lists gases potentially present in municipal sewers and wastewater treatment facilities.

Table 19-1. Potential Sewer Gases

Gas	Chemical Formula	Common Properties	Explosivity	Location with Highest Concentration
Methane	CH_4	Colorless, odorless	Moderate	Near top
Hydrogen Sulfide	H_2S	Colorless, rotten egg odor, poisonous	Moderate	Near bottom
Carbon Dioxide	CO_2	Colorless, odorless	None	Bottom
Carbon Monoxide	CO	Colorless, odorless, poisonous	None	Top
Chlorine	Cl_2	Yellow-green, pungent odor, poisonous	Low	Bottom
Gasoline (fumes)	C_8H_{18}	Colorless, but odor highly noticeable, flammable	High	Near bottom
Hydrogen	H_2	Colorless, odorless, flammable	High	Top
Nitrogen	N_2	Colorless	None	Uniform
Oxygen	O_2	Colorless, odorless, highly reactive	None	Uniform

19.2.4 Electrical Equipment

With major pieces of electrical equipment spread throughout the WRP, there are many opportunities for electric shock. Electrical shocks of 10 mA are severe. Electrical shocks of 100 mA are lethal. Even low-voltage or amperage control circuitry may produce these shocks if a person is properly grounded. An electrical shock can produce both trivial and serious injuries. For example, if the contact is poor or of short duration, a muscular contraction and a numbing sensation may be the only results. However, good contact between a well-grounded body and current of adequate strength and duration can result in electrocution.

Low-voltage (110 to 220 volts) currents sustained for over 2 seconds frequently cause a quivering of the heart muscles (ventricular fibrillation). High-voltage currents are more liable to produce muscle contraction, unconsciousness, respiratory paralysis, cardiac arrest, and severe burns at contact points.

To help avoid the risk of electrical shock, the following safety precautions, at a minimum, should be observed:

- Never work on electrical equipment unless you are thoroughly familiar with it; know precisely what you are trying to accomplish and the safe method of accomplishing it.
- When electrical problems develop, seek the help of a trained, licensed electrician.
- It is critical that you make certain that any electrical equipment being repaired or inspected is completely isolated from all sources of electrical power. For example, in the case of the fine screen at the headworks, this means shutting off the power at the MCC, and turning the local JOR switch next to the screen to the OFF position.
- Before repairing any electrical equipment, the individual starter, breaker, or switch should be locked in the OFF position and tagged to prevent being turned on. In some cases, even with the switches in the OFF position, the supply side of the switch is still “live.”

19.2.5 Mechanical Equipment

All of the mechanical equipment at the WRP is electrically operated; therefore, electrical hazards exist. In addition, there are dangers from contact with rotating shafts, drives, and impellers; and inadvertent automatic operation of equipment during maintenance or repair. Prevention of physical injuries can be accomplished by following these procedures:

1. Utilize proper lifting techniques.
2. Disconnect equipment at the motor control center before working on it. A tag and a padlock on the breaker switch should prevent the inadvertent reactivation of power by other WRP personnel. While in many cases it would appear unlikely that a hazard would be created by turning on a piece of equipment with only a single operator at the WRP, locking out the equipment also prevents the inadvertent activation of a piece of equipment before it is ready to be put back into service.
3. Utilize good housekeeping techniques to prevent falls.
4. Exercise care when working around rotating parts, shafts, or mechanisms. Moving equipment may start automatically.
5. Wear a hard hat, boots, and protective clothing as appropriate.
6. Make sure equipment is de-energized or de-pressurized, as appropriate.
7. Close valves upstream and downstream of process lines being serviced.
8. Never operate any machinery without guards and protective devices.
9. Keep clear of equipment being lifted with the bridge crane or hoists.
10. Open valves slowly to prevent water hammer or surges.

19.2.6 Explosion and Fire

Exercising proper maintenance and housekeeping procedures is the best protection against accidental explosions or fires. The operator of the WRP should impress on personnel and visitors the danger of smoking, dropping lighted matches or burning cigarettes, and using open flames in or around sewers, septic tanks, service manholes, wet wells, and the standby generator/fuel tank. Other sources of explosion and fire are the WRP electrical system, stored flammable materials, and propane.

All personnel should be thoroughly familiar with fire extinguisher operation and locations.

Extinguishers should be checked annually for pressure and condition of the dry chemicals.

The WRP operator and personnel should learn the classification of fires:

- Class A – Ordinary combustible material such as wood, coal, paper, or fabrics where wetting and cooling is the method of extinguishment.
- Class B – Flammable petroleum products or other flammable liquids, where oxygen must be excluded for extinguishment.
- Class C – Fires in or near energized electrical equipment where, because use of water would be hazardous, a “non-conducting” extinguishing agent must be used.

19.2.7 Health Practices

Disease causing organisms are ever present in raw wastewater and treated wastewater. Taking the following precautions can prevent infections:

- Wear gloves and protective clothing to avoid direct exposure with wastewater. Wash hands after every routine or accidental contact and rinse in a bactericidal solution. Take a shower if necessary; a shower is provided in the WRP Locker Room for this purpose.
- Do not eat, drink, or smoke in an exposed area.
- While working around wastewater, keep hands away from your face. Infections are easily transmitted through the nose, mouth, eyes, and ears.
- Receive regular tetanus and hepatitis immunizations. Have an annual medical examination.
- Seek medical attention promptly if you have symptoms of illness such as diarrhea or stomach pains.
- Seek medical attention promptly if you develop a rash or other signs of dermal infection.
- Clothes that have been contaminated with sewage should be washed separately from the family laundry; laundry machines are provided in the WRP Locker Room for this purpose.

19.2.8 Falling

To avoid falling hazards, practice the following precautions:

- Use caution when walking on wet or slippery surfaces.
- Place safety cones around open manholes and vaults.
- For elevated work, ensure that appropriate safety harnesses or fall restraints are used.
- If work requires the use of a ladder, use the appropriate ladder type with an appropriate weight capacity to safely support the combined weight of the user and equipment. If an extension-type ladder will remain in place for an extended period, secure the top of the ladder to a fixed structure to prevent tipping.

19.2.9 Building Ventilation

Building ventilation systems should be kept in operation at all times to ventilate gases and to provide a fresh air supply to the building. Prompt action should be taken to restore ventilation in the event of equipment failure.

19.2.10 Chemical Safety

Become familiar with the chemicals being stored and used on site. Safety Data Sheets (SDS) provide detailed information on each of the chemicals used on-site and copies should be kept in the Operations Building. A chemical or chemical storage device should never be handled without first becoming familiar with the Safety Data Sheets (SDS).

19.3 Laboratory Safety

It is important that all WRP personnel be fully alert and aware of all the potential hazards present in the Operations Building. Routine laboratory procedures are potentially harmful through improper handling of hazardous chemicals and contact with potentially infectious wastewater and sludge. Only trained or certified personnel should be allowed to work on-site.

The following safety procedures are included for information purposes. The procedures are not a definitive list, but should provide a sound basis for a safe working environment. Proper housekeeping will avoid most hazards. A clean, neat building and proper chemical storage are necessary. Communication and mitigation of potentially unsafe conditions or practices is crucial to a safe work environment. Awareness and common sense should be exercised at all times. Periodic reorientation and review of practices used by personnel should be made on a scheduled basis to achieve the goal of continued safe procedures.

19.3.1 Chemical and Wastewater Handling

Many chemicals are potentially harmful to the health of the operator either through inhalation or absorption through the skin. This is especially true for solvents. Other chemicals may be highly reactive, explosive, or caustic, and should be handled accordingly. The following is a list of general safety practices that should be followed when handling chemicals (the same care should be exercised when handling raw or treated wastewater samples):

- Always wear the necessary safety equipment (closed-toed shoes, gloves, etc.). Goggles or eye shields should be worn at all times. Never handle chemicals or raw and treated wastewater with bare hands.
- Smoking and eating should not be allowed when working with infectious materials, such as wastewater and raw sludge.
- Food items should not be stored in the refrigerator with chemicals and wastewater samples.
- All chemicals and samples should be clearly labeled, dated, and properly stored.
- Chemicals and wastewater should not be handled with bare hands. Nitrile rubber gloves should be worn when handling chemicals and solvents. Latex rubber gloves can only prevent dermal exposure to biological/infectious waste, but are permeable to most solvents.
- Special explosion-proof cans should be used for the storage of solvents. Solvents should not be stored in a refrigerator, because the light and controls are potential sources of ignition.
- Do not mix chemicals or waste solutions without first verifying compatibility of the two.
- Particular care is required with concentrated acids and bases. A concentrated acid should always be added to water and not water to the acid. Always pour concentrated solutions down the side of the container—never pour directly into the solution.

Any chemicals handled in the Operations Building need to be stored and disposed of by safe and acceptable methods. Waste chemical solutions should not be poured down the sink as standard practice, but should be handled according to current chemical specific regulations. The Washington State Department of Ecology (Ecology) has fact sheets outlining how to identify, report, store, reduce, recycle, and dispose of small and large amounts of hazardous waste. Contact the regional office and ask for the “Step by Step Fact Sheet for Hazardous Waste Generators.” This is a resource provided under the Ecology Solid and Hazardous Waste Program.

20. EMERGENCY PLANS AND PROCEDURES

This section will present information that will allow the safe and continued operation of the WRP under various types of emergency conditions. It will also aid in reducing the frequency of certain emergency events through better operation, planning, preparation, and maintenance. A plan of action should be thought through for each alarm and warning condition.

20.1 Introduction

An emergency is any occurrence that may arise that can endanger human life, damage the WRP equipment, or interfere with the treatment process. In any emergency event, the most important rule to be concerned with is the safety of people first, then the safety and operation of the WRP. The operator should be alert to the dangers involved in the possible exposure to unsafe conditions. In many cases, there will only be one operator present at the WRP, making the prevention of unsafe conditions even more important. In this regard, a program should be developed to review possible emergency conditions on a regular basis and to prepare the appropriate counter-actions. This program should be carefully reviewed, practiced, and revised as necessary.

The phone numbers of emergency contacts, agencies, and utilities for reference in case of an emergency are listed in Table 20-1. It is recommended that these numbers be posted visibly in the Operations Building Lab/Office and in other areas where chemical spills/leaks, explosions, and other potential hazards exist.

Table 20-1. Emergency Contact List

All Emergency Situations Requiring Immediate Response	**911**
ilani Resort Security	(360) 887-6767
Clark County Sheriff	(360) 397-2211
Clark County Fire & Rescue	(360) 887-4609
Hospitals	
Legacy Salmon Creek Medical Center: Emergency Room (Vancouver)	(360) 487-1000
PeaceHealth Southwest Medical Center (Vancouver)	(360) 514-2000
Cowlitz Indian Tribe Health and Human Services	(360) 575-8275
Poison Information Center	1-800-222-1222
Chemical Emergency Spill, Leak, Exposure, Fire, or Accident	
Chemtrec Emergency, 24-Hour Hotline	1-800-424-9300
EPA – Regional Office, Seattle	(206) 553-1200
Environmental Emergencies	(206) 553-4973
National Response Center	1-800-424-8802
Environmental Education Clearinghouse	1-800-424-4372
Hazardous Material Identification (CAS)	1-800-631-1884
National Institute of Occupational Safety and Health (NIOSH)	1-800-232-4636
Department of Ecology Southwest Region	(360) 407-6300
Clark Public Utilities (Power)	(360) 992-3000
Comcast (Communications Service)	1-800-934-6489
Utilities Underground Location Center	1-800-424-5555
Engineer – Allan Maas, Parametrix	(253) 604-6600

20.2 Emergency Events

Possible emergency events that the operator should anticipate and be prepared for include the following:

- Natural disasters such as earthquake, severe weather, flooding, and fire.
- Service utility failure.
- Equipment failure.
- Personal injury.
- Fire.

The paragraphs below discuss procedures that should be followed in the case of an emergency event.

20.2.1 Earthquake

While the possibility of an earthquake severe enough to affect the WRP operation is remote, the operator should be aware of precautions that can be taken to minimize earthquake hazards. Chemicals and equipment in the Operations Building should be stowed to minimize the chance of falling. All cabinets and shelves should be securely anchored to a wall; store heavy equipment on lower shelves whenever possible.

In the event of an earthquake, watch for power outages or short-circuiting and be prepared to cut power to portions of the WRP. Inspect all structures, piping, mechanical, and electrical equipment for damage.

20.2.2 Freezing

In the event of severe cold weather, the operator should check the operation of the WRP more frequently to ensure that pipes do not freeze.

The interior hose bibbs are not freeze-proof and require draining in the winter to prevent freezing. Run plant water fixtures as necessary to prevent freezing. Keep heaters in good operating condition. The standby generator should be exercised and fuel level checked at the onset of freezing weather.

20.2.3 Chemical Spill

Small chemical spills should be mopped up immediately with absorbent sponges or other materials designed for this purpose. Acids and bases may require neutralization. If in doubt of the health and chemical compatibility hazards of the chemical, consult the safety data sheet or call one of the numbers listed in Table 20-1. Wear a respirator when required and provide proper ventilation. Turn on all exhaust fans available in the room in which the spill has taken place.

SAFETY NOTE! Sodium hypochlorite is a strong oxidant and is listed as an “Incompatible” substance with oxalic acid. A simultaneous spill of oxalic acid and sodium hypochlorite solutions will result in a heat-generating reaction. Take particular care to keep any anhydrous or dry, powdered oxalic acid away from liquid sodium hypochlorite, as a more violent reaction will occur.

Large spills of sodium hypochlorite should be mopped up as much as possible. If a large sodium hypochlorite spill is flushed into the drain sump, the drain pump should be run intermittently so as to slowly meter any chlorine back into the WRP. A large pulse of chlorine will be detrimental to the biology in the treatment units.

Large spills of liquid oxalic acid should be mopped up as much as possible. If a large oxalic acid spill is flushed into the drain sump, the drain pump should be run intermittently to slowly meter any acid back into the WRP. The pH of the system should be monitored while the acid is being introduced into the treatment plant. Spills of dry oxalic acid powder should be swept up carefully and disposed of per the safety data sheet.

20.2.4 Fire/Explosion

In the event of a fire/explosion, evacuate the facility immediately and call the fire department and appropriate emergency management agencies. Minor fires may be extinguished with the fire extinguishers located in the Operations Building.

20.2.5 Service Utility Failure

The on-site generator is designed to handle all plant loads for a power outage duration of approximately 24 hours before it requires refueling.

20.2.6 Shock Loads and Discharge Events

It is possible that a shock load due to accidental chemical spill could occur. Because MBRs run at a high MLSS concentration, the effect will likely not be as severe as with traditional activated sludge. However, if such an event occurs, the operator should divert flows to equalization until MLSS concentrations return to design values, then meter in any remaining chemical as a dilution method. Notify the Department of Ecology if a spill occurs.

20.2.7 Personal Injury

The following checklist gives the procedures to be followed in the event of an injury to somebody at the WRP:

- For emergencies resulting from medical causes, call the local ambulance or fire department (dial 911).
- For accidents resulting from falling, fire, gas, explosion, etc., call the fire department for a rescue unit immediately (dial 911).
- If qualified, render first aid. If not qualified, attempt to find someone who is qualified.
- Never move an injured or seriously ill person unless necessary to prevent further injury.
- It is strongly recommended that a medical history and information card be maintained for each employee. Use this card when accidents, illness, or injuries occur.

Often there will only be a single operator present at the WRP. Other staff should know the operators' schedules and keep apprised of the fact that if an operator does not check in by a certain time, then someone should go to the WRP to check if there is a problem. All personnel injuries should be reported to the appropriate personnel.

20.2.8 First Aid

In many emergency situations, first aid could mean the difference between life and death, temporary or permanent disability, and short- or long-term hospitalization. An operator with first aid knowledge can potentially prevent fatal outcomes in the event of an accident involving either himself/herself or another coworker. It is strongly recommended that all operators become first aid and CPR certified, and that all plant staff are made familiar with the locations and types of first aid equipment available at the WRP.

The following is a list of general guidelines that should be followed prior to administering first aid to a victim in the event of an accident:

- Call for help (dial 911), or send someone else to call for help while attending the victim.
- Do not move the victim unless unsafe conditions absolutely call for it. In some instances it may be necessary to move the victim prior to calling for help.
- Determine the most appropriate position for the victim, and do not let the victim stand up or try to walk.
- Treat the victim to minimize the onset of shock by having them lie on their back with feet slightly elevated if possible, and prevent chilling by covering the victim with blankets or suitable covers.
- Examine the victim in a systematic manner, paying special attention to the nature of the accident and the needs of the situation—have reasons for what you do.
- Administer the appropriate first aid procedures.

Table 20-2 below lists general first aid techniques for some common injuries; general first aid information should be displayed prominently in the Operations Building laboratory area. In all cases, seek professional medical attention after applying first aid.

Table 20-2. General First Aid Techniques

Injury	First Aid
Bleeding	Apply pressure with a clean pad to the wound. Elevate the wound unless there is a possibility of bone fractures. Do not disturb blood clots.
Thermal Burns	If there is no blistering, immerse the burn in clean, cold water; cover it with a clean cloth until help arrives.
Chemical Burns	Flush the affected area with running water; remove contaminated clothing and cover the affected area with a clean cloth.
Electrical Shock	Shut off power and remove the victim from the current source; if victim is not breathing, apply artificial respiration; if the victim has no pulse, administer CPR.
Shock	Place the victim on their back with feet higher than their head unless there is the possibility of bone fractures; check for breathing; apply artificial respiration if necessary; loosen victim’s clothing.
Chemical Eye Injury	Flush victim’s eyes with water for at least 15 minutes; remove any dry chemicals from the eyes, and cover the eyes with a clean pad.
Eye Injury Due to a Foreign Object	Encourage the victim to tear without rubbing the eyes, which may dislodge the object; flush the eyes with water.
Toxic Gas Poisoning	Get the victim to fresh air; check for breathing and apply artificial respiration or CPR if necessary.
Heat Stroke	Lower the victim’s body temperature by applying water or rubbing alcohol to the skin or placing the victim in a cold water bathtub.

Appendix A

EPA Underground Injection Control Requirements

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, Washington 98101-3140

MAY 1 1 2017

OFFICE OF
COMPLIANCE AND ENFORCEMENT

Reply To: OCE-101

Chairman William Iyall P.E.
Cowlitz Indian Tribe
P.O. Box 2547
Longview, Washington 98632

Re: Underground Injection Control Program
Authorization by Rule of Seven Injection Wells for Disposal of Wastewater Treatment Plant Effluent, Cowlitz Reservation Development
UIC ID No. WA132T5-30-13798

Dear Mr. Iyall:

The Environmental Protection Agency, Region 10 (EPA) Underground Injection Control (UIC) Program is in receipt of inventory information, submitted by Parametrix on behalf of the Cowlitz Indian Tribe (Tribe), for seven new Class V injection wells for use at the Cowlitz Reservation Development, 3600 NW 319th Street, Ridgefield, Washington. In July 2015, EPA received the first submittals, which included a copy of the *Feasibility Study* and *Draft GMP Plans* dated July 22, 2015; and *Inventory of Injection Wells Registration* and *Plan Sheet C-16 – Injection Well Site Plan* dated July 27, 2015. EPA sent the Tribe technical comments regarding the submissions in a letter, dated September 4, 2015. The Tribe has provided supplemental information on numerous occasions in response to EPA's technical comments on the design, operation and monitoring of the injection wells. With this letter, EPA is providing a summary of the information submitted to the Agency to date through our ongoing oversight responsibilities of injection wells on Tribal lands. EPA is also including advisory recommendations provided as a courtesy, for the Tribe's consideration. These recommendations are outside the scope of EPA's minimum federal requirements for injection wells authorized by rule.

Thank you for submitting your inventory information to EPA. Documents and specifications provided by the Tribe and Parametrix show that the seven Class V injection wells are for the disposal of treated wastewater effluent. Pursuant to 40 C.F.R. §§ 144.24 and 144.26, the wells were inventoried with EPA upon receipt of EPA Form 7520-16. The requested additional information has been added to the UIC inventory file of injection wells for the Cowlitz Reservation Development (UIC ID No. WA132T5-30-13798). All future correspondence related to these injection wells should include a reference to this assigned UIC identification number.

The Cowlitz Indian Tribe is responsible for meeting all applicable UIC requirements under the Safe Drinking Water Act, including the prohibition against conducting any injection activity in a manner that allows the movement of fluid containing any contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation under 40 CFR part 141 or may otherwise adversely affect the health of persons.

The Class V injection wells described in the inventory form and supplemental information are summarized below:

1. The Tribe constructed seven injection wells for disposal of up to 200,000 gallons per day (gpd) of wastewater treatment plant effluent from the Cowlitz Reservation Development at 3600 NW 319th Street, Ridgefield, Washington.

2. Each injection well is 12-inches in diameter and injects treated effluent into the vadose zone through a screened interval approximately 60 to 160 feet below ground surface (bgs). This depth represents the unsaturated portions of the Upper Troutdale Aquifer and Sand and Gravel Aquifer geologic units. The Tribe reports a vertical separation of approximately 120 feet between the lowermost point of injection and the top of the saturated portion of the Sand and Gravel Aquifer geologic unit at approximately 280 feet bgs.

3. The injection well system will initially operate with one duty well and one redundant or standby well. The two initially operated injection wells each have the capacity for disposal of the design maximum flow of 200,000 gpd of treated wastewater plant effluent. The remaining five injection wells will remain temporarily out-of-service until needed and can be activated using the water reclamation plant's remote operating system. As described in Chapter 14 of the Operation and Maintenance Manual (O&M Manual), the Tribe shall notify EPA when a different well has been placed into service and determine if a new monitoring well is needed in the line of flow from the new injection well.

4. The wastewater is generated by Tribal facilities within the Cowlitz Reservation Development and treated at the Tribe's water reclamation plant. The plant was designed using the Washington State Department of Ecology *Criteria for Sewage Works Design Manual* and employs Membrane Bioreactor (MBR) treatment with denitrification prior to disinfection. The plant is constructed with four separate MBR process trains. Two treatment trains are fully equipped for current operations while the other two trains will be reserved for future capacity needs. The Tribe will also be implementing best management practices that include fats, oils and grease reduction and other best management practices to minimize loading on the wastewater system at the Cowlitz Reservation Development facilities.

5. The O&M Manual, developed by the Tribe, is designed as a general guide for the operation and maintenance of the water reclamation plant. As described in the introduction of the O&M Manual, the O&M Manual provides overall operating strategy and functional descriptions, including normal and emergency operation, start-up/shutdown procedures, and maintenance of the systems and components of the plant. It also includes injection well system design assumptions, operating parameters, maintenance and abandonment protocols and an overview of EPA UIC regulations for a rule authorized injection system.

6. The O&M Manual also includes a laboratory and sampling plan that specifies monitoring parameters and frequencies for the water reclamation plant and injection wells. Operators will conduct monitoring of the wastewater at points within the treatment process, of the treated wastewater effluent, and groundwater at monitoring wells beneath and downgradient of the injection area to verify and ensure the treated effluent entering the wells meets primary drinking water standards in the aquifer and determine whether there are any unanticipated impacts to the aquifer.

a. Plant operators will analyze wastewater samples from within the treatment process using the on-site laboratory. Testing will include typical wastewater treatment parameters, including dissolved oxygen, turbidity, pH, temperature, total suspended solids (TSS), 5-day biochemical oxygen demand (BOD), total coliform (TC) bacteria and free chlorine residual. Based on the EPA's recommendation, samples of the treated effluent will also be analyzed for total organic carbon.

b. A laboratory certified by a recognized accrediting organization will test plant effluent and samples from downgradient monitoring wells for primary drinking water standards. Water reclamation plant effluent will be sampled and tested quarterly for the first year and semiannually thereafter;

7. The Tribe has installed three monitoring wells within the development property. An upgradient well will be used to determine background water quality and two downgradient monitoring wells are located to sample groundwater downgradient of the injection zone. The monitoring schedule for each monitoring well is based on the Tribe's groundwater modeling. The wells were drilled in late March to early April 2017 and well logs are currently being compiled. Once completed, the well logs will be provided to EPA and included along with sampling depths in the O&M Manual.

    a. The monitoring well upgradient of the injection wells is completed with three 5-ft screen sections between 328 and 357 feet bgs. Samples will be collected as needed for purposes of establishing background water quality within the aquifer at depths corresponding to local drinking water wells.

    b. The first downgradient monitoring well is located within the well field, north of well 6 and is screened just below the groundwater table. The Tribe's groundwater modeling indicates treated effluent is expected to reach this monitoring well within six months of initial injection. Therefore, samples will be collected semiannually for the first two years and annually thereafter.

    c. The second monitoring well downgradient of the injection wells, on the north side of the property, is screened at a depth most likely to capture injectate and at a similar depth to local drinking water wells. The Tribe's groundwater modeling indicates groundwater intermixed with treated effluent is expected to reach this monitoring well within four years of initial injection. Therefore, samples will be collected annually following the third year of operation.

8. The Tribe installed both ultraviolet light and chemical disinfection systems to treat plant effluent prior to injection. The chlorine disinfection system will maintain a target effluent chlorine residual of 0.5 mg/L. Plant operators will monitor chlorine residual downstream of the reclaimed water storage tank and at each of the injection wells.

9. In the event of wastewater treatment system failure, plant operators will stop injection activity and will direct flow to the reclaimed water storage tanks. During the first phase of construction, operators may also use wastewater treatment process trains 3 and 4 for emergency storage. This protocol is detailed in Chapter 7 of the O&M Manual. Consistent with the Washington State Department of Ecology *Criteria for Sewage Works Design*

Manual, the water reclamation plant will have at least 2 days of storage or excess treatment capacity.

As noted above in this letter, EPA is providing the following recommendations for the Tribe's consideration:

1. While UIC regulations require compliance with the primary drinking water regulations, the Tribe may find it helpful to expand effluent monitoring beyond primary drinking water regulations to include secondary drinking water standards and/or Washington State drinking water standards.

2. Consider including a plan for higher sampling frequencies in the O&M Manual if routine sampling finds an exceedance or near-exceedance of a relevant drinking water standard.

3. Section 18.1.4 of the O&M Manual suggests a sample containing unusual particles should be rejected. The validity of an analytical result can be properly assessed by using effective quality assurance/quality control (QA/QC) procedures. Furthermore, it is important that sampling properly characterize effluent quality during both upset and normal operating conditions. The Tribe should clarify or modify the language of Section 18.1.4 in the O&M Manual to ensure representative sampling occurs for both routine and non-routine operating conditions and is consistent with the language present in Section 18.1.3 of the O&M Manual.

4. The Tribe's current monitoring tables include relevant monitoring and sampling information; however, consolidating additional details (e.g., maximum contaminant level, analytical method, expected range under normal operation) in the sampling schedule in the O&M Manual may be very beneficial when conducting daily operations. EPA can provide examples of similar approaches upon request.

5. Develop and implement a Quality Assurance Plan (QAP) at the on-site laboratory in conjunction with Chapter 18 of the O&M Manual. The QAP should include QA/QC procedures to assess the validity and acceptability of analytical results.

6. As recommended by the Tribe's hydrogeology consultant, Pacific Groundwater Group, the Tribe should collect an initial sample from each monitoring well for the approved set of parameters before or soon after infiltration of reclaimed water.

7. The Tribe's groundwater modeling has provided the Tribe with initial operating assumptions about the behavior of treated effluent once injected into the subsurface. The Tribe has used this information to align monitoring wells to intercept groundwater intermixed with treated effluent at points downgradient of the two active injection wells. As active injection wells reach the end of their useful life, additional injection wells will need to be used and thus additional monitoring wells may be needed. For example, at an operating rate of 100,000 gpd, Figure 1 from Appendix E of the O&M Manual shows a plume approximately 650 feet wide that does not spread out much in the downgradient direction indicating that advection is the dominant transport process and that dispersion is relatively minor. In the coming years, the Tribe could validate this prediction by comparing the model to empirical monitoring data.

8. Another way for the Tribe to validate model predictions would be to install additional monitoring wells to determine a site specific horizontal component of groundwater gradient if such information cannot be calculated from the three existing monitoring wells (MW-1, MW-2, and B-1). This information will assist the Tribe in confirming that the existing wells are adequately located to intercept groundwater intermixed with treated effluent and if necessary, further inform the need for and the placement of any future monitoring wells.

9. Consider voluntarily reporting wastewater treatment plant effluent and monitoring well sampling results (e.g., to EPA for the first year of operation).

Please submit an updated Inventory of Injection Wells form (EPA Form 7520-16) and/or notify EPA before any of the following occur:

1. A change in the operational status (as defined on EPA Form 7520-16) of an injection well (such as when a well becomes active);

2. Any change to the characteristics of effluent injected through the wells (such as an increase in wastewater volume or composition from additional facilities beyond the current inventory); or

3. Prior to construction of additional injection wells.

Please report any unauthorized discharges, including accidental spills, into the injection wells to EPA's Region 10 office within twenty-four (24) hours of the event. All reporting and notifications should be addressed to:

U. S. Environmental Protection Agency Region 10
Underground Injection Control Program
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If you have any questions, please contact Derek Schruhl of my staff at (206) 553-1146.

Sincerely,

Peter Contreras, Manager
Ground Water Unit

cc: Mr. Michael T. Ollivant, PE
Parametrix

ELECTRONIC CODE OF FEDERAL REGULATIONS

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Title 40 → Chapter I → Subchapter D → Part 144

Title 40: Protection of Environment

PART 144—UNDERGROUND INJECTION CONTROL PROGRAM

Contents

AUTHORITY: Safe Drinking Water Act, 42 U.S.C. 300f *et seq.;* Resource Conservation and Recovery Act, 42 U.S.C. 6901 *et seq.*

SOURCE: 48 FR 14189, Apr. 1, 1983, unless otherwise noted.

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Subpart A—General Provisions

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§144.1 Purpose and scope of part 144.

(a) *Contents of part 144.* The regulations in this part set forth requirements for the Underground Injection Control (UIC) program promulgated under Part C of the Safe Drinking Water Act (SDWA) (Pub. L. 93-523, as amended; 42 U.S.C. 300f *et seq.*) and, to the extent that they deal with hazardous waste, the Resource Conservation and Recovery Act (RCRA) (Pub. L. 94-580 as amended; 42 U.S.C. 6901 *et seq.*).

(b) *Applicability.* (1) The regulations in this part establish minimum requirements for UIC programs. To the extent set forth in part 145, each State must meet these requirements in order to obtain primary enforcement authority for the UIC program in that State.

(2) In addition to serving as minimum requirements for UIC programs, the regulations in this part constitute a part of the UIC program for States listed in part 147 to be administered directly by EPA.

(c) The information requirements located in the following sections have been cleared by the Office of Management and Budget: Sections 144.11, 144.28(c)(d)(i), 144.31, 14.33, 144.51(j)(m) (n), 144.52(a), 144.54, 144.55, 144.15, 144.23, 144.26, 144.27, 144.28(i)(k), 144.51(o), 146.52. The OMB clearance number is 2040-0042.

(d) *Authority.* (1) Section 1421 of SDWA requires the Administrator to promulgate regulations establishing minimum requirements for effective UIC programs.

(2) Section 1422 of SDWA requires the Administrator to list in the FEDERAL REGISTER "each State for which in his judgment a State underground injection control program may be necessary to assure that underground injection will not

endanger drinking water sources" and to establish by regulation a program for EPA administration of UIC programs in the absence of an approved State program in a listed State.

(3) Section 1423 of SDWA provides procedures for EPA enforcement of UIC requirements.

(4) Section 1431 authorizes the Administrator to take action to protect the health of persons when a contaminant which is present in or may enter a public water system or underground source of drinking water may present an imminent and substantial endangerment to the health of persons.

(5) Section 1445 of SDWA authorizes the promulgation of regulations for such recordkeeping, reporting, and monitoring requirements "as the Administrator may reasonably require * * * to assist him in establishing regulations under this title," and a "right of entry and inspection to determine compliance with this title, including for this purpose, inspection, at reasonable time, or records, files, papers, processes, controls, and facilities * * *."

(6) Section 1450 of SDWA authorizes the Administrator "to prescribe such regulations as are necessary or appropriate to carry out his functions" under SDWA.

(e) *Overview of the UIC program.* An UIC program is necessary in any State listed by EPA under section 1422 of the SDWA. Because all States have been listed, the SDWA requires all States to submit an UIC program within 270 days after July 24, 1980, the effective date of 40 CFR part 146, which was the final element of the UIC minimum requirements to be originally promulgated, unless the Administrator grants an extension, which can be for a period not to exceed an additional 270 days. If a State fails to submit an approvable program, EPA will establish a program for that State. Once a program is established, SDWA provides that all underground injections in listed States are unlawful and subject to penalties unless authorized by a permit or a rule. This part sets forth the requirements governing all UIC programs, authorizations by permit or rule and prohibits certain types of injection. The technical regulations governing these authorizations appear in 40 CFR part 146.

(f) *Structure of the UIC program*—(1) *Part 144.* This part sets forth the permitting and other program requirements that must be met by UIC Programs, whether run by a State or by EPA. It is divided into the following subparts:

(i) Subpart A describes general elements of the program, including definitions and classifications.

(ii) Subpart B sets forth the general program requirements, including the performance standards applicable to all injection activities, basic elements that all UIC programs must contain, and provisions for waiving permit of rule requirements under certain circumstances.

(iii) Subpart C sets forth requirements for wells authorized by rule.

(iv) Subpart D sets forth permitting procedures.

(v) Subpart E sets forth specific conditions, or types of conditions, that must at a minimum be included in all permits.

(vi) Subpart F sets forth the financial responsibility requirements for owners and operators of all existing and new Class I hazardous waste injection wells.

(vii) Subpart G of this part sets forth requirements for owners and operators of Class V injection wells.

(viii) Subpart H of part 146 sets forth requirements for owners or operators of Class VI injection wells.

(2) *Part 145.* While part 144 sets forth minimum requirements for all UIC Programs, these requirements are specifically identified as elements of a State application for primacy to administer an UIC Program in part 145. Part 145 also sets forth the necessary elements of a State submission and the procedural requirements for approval of State programs.

(3) *Part 124.* The public participation requirements that must be met by UIC Programs, whether administered by the State or by EPA, are set forth in part 124. EPA must comply with all part 124 requirements; State administered programs must comply with part 124 as required by part 145. These requirements carry out the purposes of the public participation requirement of 40 CFR part 25 (Public Participation), and supersede the requirements of that part as they apply to the UIC Program.

(4) *Part 146.* This part sets forth the technical criteria and standards that must be met in permits and authorizations by rule as required by part 144.

(g) *Scope of the permit or rule requirement.* The UIC permit program regulates underground injection by six classes of wells (see definition of "well injection," §144.3). The six classes of wells are set forth in §144.6. All owners or operators of these injection wells must be authorized either by permit or rule by the Director. In carrying out the mandate of the SDWA, this subpart provides that no injection shall be authorized by permit or rule if it results in the movement of fluid containing any contaminant into underground sources of drinking water (USDWs—see §144.3 for definition), if the presence of that contaminant may cause a violation of any primary drinking water regulation under 40 CFR part 141 or may adversely affect the health of persons (§144.12). Existing Class IV wells which inject hazardous waste directly into an underground source of drinking water are to be eliminated over a period of six months and new such Class IV wells are to be prohibited (§144.13). For Class V wells, if remedial action appears necessary, a permit may be required (§144.25) or the Director must require remedial action or closure by order (§144.6(c)). During UIC program development, the Director may identify aquifers and portions of aquifers which are actual or potential sources of drinking water. This will provide an aid to the Director in carrying out his or her duty to protect all USDWs. An aquifer is a USDW if it fits the definition under §144.3, even if it has not been "identified." The Director may also designate "exempted aquifers" using the criteria in 40 CFR 146.4 of this chapter. Such aquifers are those which would otherwise qualify as "underground sources of drinking water" to be protected, but which have no real potential to be used as drinking water sources. Therefore, they are not USDWs. No aquifer is an exempted aquifer until it has been affirmatively designated under the procedures at §144.7. Aquifers which do not fit the definition of "underground source of drinking water" are not "exempted aquifers." They are simply not subject to the special protection afforded USDWs. During initial Class VI program development, the Director shall not expand the areal extent of an existing Class II enhanced oil recovery or enhanced gas recovery aquifer exemption for Class VI injection wells and EPA shall not approve a program that applies for aquifer exemption expansions of Class II-Class VI exemptions as part of the program description. All Class II to Class VI aquifer exemption expansions previously issued by EPA must be incorporated into the Class VI program descriptions pursuant to requirements at §145.23(f)(9).

(1) *Specific inclusions.* The following wells are included among those types of injection activities which are covered by the UIC regulations. (This list is not intended to be exclusive but is for clarification only.)

(i) Any injection well located on a drilling platform inside the State's territorial waters.

(ii) Any dug hole or well that is deeper than its largest surface dimension, where the principal function of the hole is emplacement of fluids.

(iii) Any well used by generators of hazardous waste, or by owners or operators of hazardous waste management facilities, to dispose of fluids containing hazardous waste. This includes the disposal of hazardous waste into what would otherwise be septic systems and cesspools, regardless of their capacity.

(iv) Any septic tank, cesspool, or other well used by a multiple dwelling, community, or Regional system for the injection of wastes.

(2) *Specific exclusions.* The following are not covered by these regulations:

(i) Injection wells located on a drilling platform or other site that is beyond the State's territorial waters.

(ii) Individual or single family residential waste disposal systems such as domestic cesspools or septic systems.

(iii) Non-residential cesspools, septic systems or similar waste disposal systems if such systems (A) Are used solely for the disposal of sanitary waste, and (B) have the capacity to serve fewer than 20 persons a day.

(iv) Injection wells used for injection of hydrocarbons which are of pipeline quality and are gases at standard temperature and pressure for the purpose of storage.

(v) Any dug hole, drilled hole, or bored shaft which is not used for the subsurface emplacement of fluids.

(3) The prohibition applicable to Class IV wells under §144.13 does not apply to injections of hazardous wastes into aquifers or portions thereof which have been exempted pursuant to §146.04.

(h) *Interim Status under RCRA for Class I Hazardous Waste Injection Wells.* The minimum national standards which define acceptable injection of hazardous waste during the period of interim status under RCRA are set out in the applicable provisions of this part, parts 146 and 147, and §265.430 of this chapter. The issuance of a UIC permit does not automatically terminate RCRA interim status. A Class I well's interim status does, however, automatically terminate upon issuance to that well of a RCRA permit, or upon the well's receiving a RCRA permit-by-rule under §270.60(b) of this chapter. Thus, until a Class I well injecting hazardous waste receives a RCRA permit or RCRA permit-by-rule, the well's interim status requirements are the applicable requirements imposed pursuant to this part and parts 146, 147, and 265 of this chapter, including any requirements imposed in the UIC permit.

[48 FR 14189, Apr. 1, 1983, as amended at 49 FR 20181, May 11, 1984; 52 FR 20676, June 2, 1987; 52 FR 45797, Dec. 1, 1987; 53 FR 28147, July 26, 1988; 64 FR 68565, Dec. 7, 1999; 67 FR 39592, June 7, 2002; 75 FR 77286, Dec. 10, 2010]

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§144.2 Promulgation of Class II programs for Indian lands.

Notwithstanding the requirements of this part or parts 124 and 146 of this chapter, the Administrator may promulgate an alternate UIC Program for Class II wells on any Indian reservation or Indian lands. In promulgating such a program the Administrator shall consider the following factors:

(a) The interest and preferences of the tribal government having responsibility for the given reservation or Indian lands;

(b) The consistency between the alternate program and any program in effect in an adjoining jurisdiction; and

(c) Such other factors as are necessary and appropriate to carry out the Safe Drinking Water Act.

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§144.3 Definitions.

Terms not defined in this section have the meaning given by the appropriate Act. When a defined term appears in a definition, the defined term is sometimes placed within quotation marks as an aid to readers.

Administrator means the Administrator of the United States Environmental Protection Agency, or an authorized representative.

Application means the EPA standard national forms for applying for a permit, including any additions, revisions or modifications to the forms; or forms approved by EPA for use in approved States, including any approved modifications or revisions.

Appropriate Act and regulations means the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (RCRA); or Safe Drinking Water Act (SDWA), whichever is applicable; and applicable regulations promulgated under those statutes.

Approved State Program means a UIC program administered by the State or Indian Tribe that has been approved by EPA according to SDWA sections 1422 and/or 1425.

Aquifer means a geological "formation," group of formations, or part of a formation that is capable of yielding a significant amount of water to a well or spring.

Area of review means the area surrounding an injection well described according to the criteria set forth in §146.06 or in the case of an area permit, the project area plus a circumscribing area the width of which is either ¼ of a mile or a number calculated according to the criteria set forth in §146.06.

Cesspool means a "drywell" that receives untreated sanitary waste containing human excreta, and which sometimes has an open bottom and/or perforated sides.

Contaminant means any physical, chemical, biological, or radiological substance or matter in water.

Director means the Regional Administrator, the State director or the Tribal director as the context requires, or an authorized representative. When there is no approved State or Tribal program, and there is an EPA administered program, "Director" means the Regional Administrator. When there is an approved State or Tribal program, "Director" normally means the State or Tribal director. In some circumstances, however, EPA retains the authority to take certain actions even when there is an approved State or Tribal program. In such cases, the term "Director" means the Regional Administrator and not the State or Tribal director.

Draft permit means a document prepared under §124.6 indicating the Director's tentative decision to issue or deny, modify, revoke and reissue, terminate, or reissue a "permit." A notice of intent to terminate a permit, and a notice of intent to deny a permit, as discussed in §124.5 are types of "draft permits." A denial of a request for modification, revocation and reissuance, or termination, as discussed in §124.5 is not a "draft permit."

Drilling mud means a heavy suspension used in drilling an "injection well," introduced down the drill pipe and through the drill bit.

Drywell means a well, other than an improved sinkhole or subsurface fluid distribution system, completed above the water table so that its bottom and sides are typically dry except when receiving fluids.

Eligible Indian Tribe is a Tribe that meets the statutory requirements established at 42 U.S.C. 300j-11(b)(1).

Emergency permit means a UIC "permit" issued in accordance with §144.34.

Environmental Protection Agency ("EPA") means the United States Environmental Protection Agency.

EPA means the United States "Environmental Protection Agency."

Exempted aquifer means an "aquifer" or its portion that meets the criteria in the definition of "underground source of drinking water" but which has been exempted according to the procedures in §144.7.

Existing injection well means an "injection well" other than a "new injection well."

Facility or activity means any UIC "injection well," or an other facility or activity that is subject to regulation under the UIC program.

Fluid means any material or substance which flows or moves whether in a semisolid, liquid, sludge, gas, or any other form or state.

Formation means a body of consolidated or unconsolidated rock characterized by a degree of lithologic homogeneity which is prevailingly, but not necessarily, tabular and is mappable on the earth's surface or traceable in the subsurface.

Formation fluid means “fluid” present in a “formation” under natural conditions as opposed to introduced fluids, such as “drilling mud.”

Generator means any person, by site location, whose act or process produces hazardous waste identified or listed in 40 CFR part 261.

Geologic sequestration means the long-term containment of a gaseous, liquid, or supercritical carbon dioxide stream in subsurface geologic formations. This term does not apply to carbon dioxide capture or transport.

Ground water means water below the land surface in a zone of saturation.

Hazardous waste means a hazardous waste as defined in 40 CFR 261.3.

Hazardous waste management facility (“HWM facility”) means all contiguous land, and structures, other appurtenances, and improvements on the land used for treating, storing, or disposing of hazardous waste. A facility may consist of several treatment, storage, or disposal operational units (for example, one or more landfills, surface impoundments, or combination of them).

HWM facility means “Hazardous Waste Management facility”

Improved sinkhole means a naturally occurring karst depression or other natural crevice found in volcanic terrain and other geologic settings which have been modified by man for the purpose of directing and emplacing fluids into the subsurface.

Indian lands means “Indian country” as defined in 18 U.S.C. 1151. That section defines Indian country as:

(a) All land within the limits of any Indian reservation under the jurisdiction of the United States government, notwithstanding the issuance of any patent, and, including rights-of-way running through the reservation;

(b) All dependent Indian communities within the borders of the United States whether within the original or subsequently acquired territory thereof, and whether within or without the limits of a State; and

(c) All Indian allotments, the Indian titles to which have not been extinguished, including rights-of-way running through the same.

Indian Tribe means any Indian Tribe having a Federally recognized governing body carrying out substantial governmental duties and powers over a defined area.

Injection well means a “well” into which “fluids” are being injected.

Injection zone means a geological “formation” group of formations, or part of a formation receiving fluids through a “well.”

Interstate Agency means an agency of two or more States established by or under an agreement or compact approved by the Congress, or any other agency of two or more States or Indian Tribes having substantial powers or duties pertaining to the control of pollution as determined and approved by the Administrator under the “appropriate Act and regulations.”

Major facility means any UIC “facility or activity” classified as such by the Regional Administrator, or, in the case of approved State programs, the Regional Administrator in conjunction with the State Director.

Manifest means the shipping document originated and signed by the “generator” which contains the information required by subpart B of 40 CFR part 262.

New injection wells means an “injection well” which began injection after a UIC program for the State applicable to the well is approved or prescribed.

Owner or operator means the owner or operator of any “facility or activity” subject to regulation under the UIC program.

Permit means an authorization, license, or equivalent control document issued by EPA or an approved State to implement the requirements of this part, parts 145, 146 and 124. “Permit” includes an area permit (§144.33) and an emergency permit (§144.34). Permit does not include UIC authorization by rule (§144.21), or any permit which has not yet been the subject of final agency action, such as a “draft permit.”

Person means an individual, association, partnership, corporation, municipality, State, Federal, or Tribal agency, or an agency or employee thereof.

Plugging means the act or process of stopping the flow of water, oil or gas into or out of a formation through a borehole or well penetrating that formation.

Point of injection means the last accessible sampling point prior to waste fluids being released into the subsurface environment through a Class V injection well. For example, the point of injection of a Class V septic system might be the distribution box—the last accessible sampling point before the waste fluids drain into the underlying soils. For a dry well, it is likely to be the well bore itself.

Project means a group of wells in a single operation.

Radioactive Waste means any waste which contains radioactive material in concentrations which exceed those listed in 10 CFR part 20, appendix B, table II, column 2.

RCRA means the Solid Waste Disposal Act as amended by the Resource Conservation and Recovery Act of 1976 (Pub. L. 94-580, as amended by Pub. L. 95-609, Pub. L. 96-510, 42 U.S.C. 6901 *et seq.*).

Regional Administrator means the Regional Administrator of the appropriate Regional Office of the Environmental Protection Agency or the authorized representative of the Regional Administrator.

Sanitary waste means liquid or solid wastes originating solely from humans and human activities, such as wastes collected from toilets, showers, wash basins, sinks used for cleaning domestic areas, sinks used for food preparation, clothes washing operations, and sinks or washing machines where food and beverage serving dishes, glasses, and utensils are cleaned. Sources of these wastes may include single or multiple residences, hotels and motels, restaurants, bunkhouses, schools, ranger stations, crew quarters, guard stations, campgrounds, picnic grounds, day-use recreation areas, other commercial facilities, and industrial facilities provided the waste is not mixed with industrial waste.

Schedule of compliance means a schedule of remedial measures included in a “permit,” including an enforceable sequence of interim requirements (for example, actions, operations, or milestone events) leading to compliance with the “appropriate Act and regulations.”

SDWA means the Safe Drinking Water Act (Pub. L. 93-523, as amended; 42 U.S.C. 300f *et seq.*).

Septic system means a “well” that is used to emplace sanitary waste below the surface and is typically comprised of a septic tank and subsurface fluid distribution system or disposal system.

Site means the land or water area where any “facility or activity” is physically located or conducted, including adjacent land used in connection with the facility or activity.

State means any of the 50 States, the District of Columbia, Guam, the Commonwealth of Puerto Rico, the Virgin Islands, American Samoa, the Trust Territory of the Pacific Islands, the Commonwealth of the Northern Mariana Islands, or an Indian Tribe treated as a State.

State Director means the chief administrative officer of any State, interstate, or Tribal agency operating an “approved program,” or the delegated representative of the State director. If the responsibility is divided among two or more States, interstate, or Tribal agencies, “State Director” means the chief administrative officer of the State, interstate, or Tribal agency authorized to perform the particular procedure or function to which reference is made.

State/EPA agreement means an agreement between the Regional Administrator and the State which coordinates EPA and State activities, responsibilities and programs.

Stratum (plural strata) means a single sedimentary bed or layer, regardless of thickness, that consists of generally the same kind of rock material.

Subsurface fluid distribution system means an assemblage of perforated pipes, drain tiles, or other similar mechanisms intended to distribute fluids below the surface of the ground.

Total dissolved solids means the total dissolved (filterable) solids as determined by use of the method specified in 40 CFR part 136.

Transferee means the owner or operator receiving ownership and/or operational control of the well.

Transferor means the owner or operator transferring ownership and/or operational control of the well.

UIC means the Underground Injection Control program under Part C of the Safe Drinking Water Act, including an “approved State program.”

Underground injection means a “well injection.”

Underground source of drinking water (USDW) means an aquifer or its portion:

(a)(1) Which supplies any public water system; or

(2) Which contains a sufficient quantity of ground water to supply a public water system; and

(i) Currently supplies drinking water for human consumption; or

(ii) Contains fewer than 10,000 mg/l total dissolved solids; and

(b) Which is not an exempted aquifer.

USDW means “underground source of drinking water.”

Well means: A bored, drilled, or driven shaft whose depth is greater than the largest surface dimension; or, a dug hole whose depth is greater than the largest surface dimension; or, an improved sinkhole; or, a subsurface fluid distribution system.

Well injection means the subsurface emplacement of fluids through a well.

[48 FR 14189, Apr. 1, 1983, as amended at 49 FR 45305, Nov. 15, 1984; 52 FR 20676, June 2, 1987; 53 FR 37412, Sept. 26, 1988; 58 FR 63895, Dec. 3, 1993; 59 FR 64345, Dec. 14, 1994; 64 FR 68565, Dec. 7, 1999; 75 FR 77287, Dec. 10, 2010]

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§144.4 Considerations under Federal law.

The following is a list of Federal laws that may apply to the issuance of permits under these rules. When any of these laws is applicable, its procedures must be followed. When the applicable law requires consideration or adoption of particular permit conditions or requires the denial of a permit, those requirements also must be followed.

(a) The *Wild and Scenic Rivers Act,* 16 U.S.C. 1273 *et seq.* Section 7 of the Act prohibits the Regional Administrator from assisting by license or otherwise the construction of any water resources project that would have a direct, adverse effect on the values for which a national wild and scenic river was established.

(b) *The National Historic Preservation Act of 1966,* 16 U.S.C. 470 *et seq.* Section 106 of the Act and implementing regulations (36 CFR part 800) require the Regional Administrator, before issuing a license, to adopt measures when feasible to mitigate potential adverse effects of the licensed activity and properties listed or eligible for listing in the National Register of Historic Places. The Act's requirements are to be implemented in cooperation with State Historic Preservation Officers and upon notice to, and when appropriate, in consultation with the Advisory Council on Historic Preservation.

(c) The *Endangered Species Act,* 16 U.S.C. 1531 *et seq.* Section 7 of the Act and implementing regulations (50 CFR part 402) require the Regional Administrator to ensure, in consultation with the Secretary of the Interior or Commerce, that any action authorized by EPA is not likely to jeopardize the continued existence of any endangered or threatened species or adversely affect its critical habitat.

(d) *The Coastal Zone Management Act,* 16 U.S.C. 1451 *et seq.* Section 307(c) of the Act and implementing regulations (15 CFR part 930) prohibit EPA from issuing a permit for an activity affecting land or water use in the coastal zone until the applicant certifies that the proposed activity complies with the State Coastal Zone Management program, and the State or its designated agency concurs with the certification (or the Secretary of Commerce overrides the States nonconcurrence).

(e) The *Fish and Wildlife Coordination Act,* 16 U.S.C. 661 *et seq.,* requires the Regional Administrator, before issuing a permit proposing or authorizing the impoundment (with certain exemptions), diversion, or other control or modification of any body of water, consult with the appropriate State agency exercising jurisdiction over wildlife resources to conserve these resources.

(f) *Executive orders.* [Reserved]

(Clean Water Act (33 U.S.C. 1251 *et seq.*), Safe Drinking Water Act (42 U.S.C. 300f *et seq.*), Clean Air Act (42 U.S.C. 7401 *et seq.*), Resource Conservation and Recovery Act (42 U.S.C. 6901 *et seq.*))

[48 FR 14189, Apr. 1, 1983, as amended at 48 FR 39621, Sept. 1, 1983]

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§144.5 Confidentiality of information.

(a) In accordance with 40 CFR part 2, any information submitted to EPA pursuant to these regulations may be claimed as confidential by the submitter. Any such claim must be asserted at the time of submission in the manner prescribed on the application form or instructions or, in the case of other submissions, by stamping the words "confidential business information" on each page containing such information. If no claim is made at the time of submission, EPA may make the information available to the public without further notice. If a claim is asserted, the information will be treated in accordance with the procedures in 40 CFR part 2 (Public Information).

(b) Claims of confidentiality for the following information will be denied:

(1) The name and address of any permit applicant or permittee;

(2) Information which deals with the existence, absence, or level of contaminants in drinking water.

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§144.6 Classification of wells.

Injection wells are classified as follows:

(a) *Class I.* (1) Wells used by generators of hazardous waste or owners or operators of hazardous waste management facilities to inject hazardous waste beneath the lowermost formation containing, within one-quarter mile of the well bore, an underground source of drinking water.

(2) Other industrial and municipal disposal wells which inject fluids beneath the lowermost formation containing, within one quarter mile of the well bore, an underground source of drinking water.

(3) Radioactive waste disposal wells which inject fluids below the lowermost formation containing an underground source of drinking water within one quarter mile of the well bore.

(b) *Class II.* Wells which inject fluids:

(1) Which are brought to the surface in connection with natural gas storage operations, or conventional oil or natural gas production and may be commingled with waste waters from gas plants which are an intergral part of production operations, unless those waters are classified as a hazardous waste at the time of injection.

(2) For enhanced recovery of oil or natural gas; and

(3) For storage of hydrocarbons which are liquid at standard temperature and pressure.

(c) *Class III.* Wells which inject for extraction of minerals including:

(1) Mining of sulfur by the Frasch process;

(2) In situ production of uranium or other metals; this category includes only in-situ production from ore bodies which have not been conventionally mined. Solution mining of conventional mines such as stopes leaching is included in Class V.

(3) Solution mining of salts or potash.

(d) *Class IV.* (1) Wells used by generators of hazardous waste or of radioactive waste, by owners or operators of hazardous waste management facilities, or by owners or operators of radioactive waste disposal sites to dispose of hazardous waste or radioactive waste into a formation which within one-quarter (1/4) mile of the well contains an underground source of drinking water.

(2) Wells used by generators of hazardous waste or of radioactive waste, by owners or operators of hazardous waste management facilities, or by owners or operators of radioactive waste disposal sites to dispose of hazardous waste or radioactive waste above a formation which within one-quarter (1/4) mile of the well contains an underground source of drinking water.

(3) Wells used by generators of hazardous waste or owners or operators of hazardous waste management facilities to dispose of hazardous waste, which cannot be classified under paragraph (a)(1) or (d) (1) and (2) of this section (e.g., wells used to dispose of hazardous waste into or above a formation which contains an aquifer which has been exempted pursuant to §146.04).

(e) *Class V.* Injection wells not included in Class I, II, III, IV, or VI. Specific types of Class V injection wells are described in §144.81.

(f) *Class VI.* Wells that are not experimental in nature that are used for geologic sequestration of carbon dioxide beneath the lowermost formation containing a USDW; or, wells used for geologic sequestration of carbon dioxide that have been granted a waiver of the injection depth requirements pursuant to requirements at §146.95 of this chapter; or, wells used for geologic sequestration of carbon dioxide that have received an expansion to the areal extent of an existing

Class II enhanced oil recovery or enhanced gas recovery aquifer exemption pursuant to §§146.4 of this chapter and 144.7 (d).

[48 FR 14189, Apr. 1, 1983, as amended at 52 FR 20676, June 2, 1987; 64 FR 68565, Dec. 7, 1999; 75 FR 77287, Dec. 10, 2010]

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§144.7 Identification of underground sources of drinking water and exempted aquifers.

(a) The Director may identify (by narrative description, illustrations, maps, or other means) and shall protect as underground sources of drinking water, all aquifers and parts of aquifers which meet the definition of "underground source of drinking water" in §144.3, except to the extent there is an applicable aquifer exemption under paragraph (b) of this section or an expansion to the areal extent of an existing Class II enhanced oil recovery or enhanced gas recovery aquifer exemption for the exclusive purpose of Class VI injection for geologic sequestration under paragraph (d) of this section. Other than EPA approved aquifer exemption expansions that meet the criteria set forth in §146.4(d) of this chapter, new aquifer exemptions shall not be issued for Class VI injection wells. Even if an aquifer has not been specifically identified by the Director, it is an underground source of drinking water if it meets the definition in §144.3.

(b)(1) The Director may identify (by narrative description, illustrations, maps, or other means) and describe in geographic and/or geometric terms (such as vertical and lateral limits and gradient) which are clear and definite, all aquifers or parts thereof which the Director proposes to designate as exempted aquifers using the criteria in §146.4 of this chapter.

(2) No designation of an exempted aquifer submitted as part of a UIC program shall be final until approved by the Administrator as part of a UIC program. No designation of an expansion to the areal extent of a Class II enhanced oil recovery or enhanced gas recovery aquifer exemption for the exclusive purpose of Class VI injection for geologic sequestration shall be final until approved by the Administrator as a revision to the applicable Federal UIC program under part 147 or as a substantial revision of an approved State UIC program in accordance with §145.32 of this chapter.

(3) Subsequent to program approval or promulgation, the Director may, after notice and opportunity for a public hearing, identify additional exempted aquifers. For approved State programs exemption of aquifers identifed (i) under §146.04(b) shall be treated as a program revision under §145.32; (ii) under §146.04(c) shall become final if the State Director submits the exemption in writing to the Administrator and the Administrator has not disapproved the designation within 45 days. Any disapproval by the Administrator shall state the reasons and shall constitute final Agency action for purposes of judicial review.

(c)(1) For Class III wells, the Director shall require an applicant for a permit which necessitates an aquifer exemption under §146.04(b)(1) to furnish the data necessary to demonstrate that the aquifer is expected to be mineral or hydrocarbon producing. Information contained in the mining plan for the proposed project, such as a map and general description of the mining zone, general information on the mineralogy and geochemistry of the mining zone, analysis of the amenability of the mining zone to the proposed mining method, and a time-table of planned development of the mining zone shall be considered by the Director in addition to the information required by §144.31(g).

(2) For Class II wells, a demonstration of commercial producibility shall be made as follows:

(i) For a Class II well to be used for enhanced oil recovery processes in a field or project containing aquifers from which hydrocarbons were previously produced, commercial producibility shall be presumed by the Director upon a demonstration by the applicant of historical production having occurred in the project area or field.

(ii) For Class II wells not located in a field or project containing aquifers from which hydrocarbons were previously produced, information such as logs, core data, formation description, formation depth, formation thickness and formation parameters such as permeability and porosity shall be considered by the Director, to the extent such information is available.

(d) *Expansion to the areal extent of existing Class II aquifer exemptions for Class VI wells.* Owners or operators of Class II enhanced oil recovery or enhanced gas recovery wells may request that the Director approve an expansion to the areal extent of an aquifer exemption already in place for a Class II enhanced oil recovery or enhanced gas recovery well for the exclusive purpose of Class VI injection for geologic sequestration. Such requests must be treated as a revision to the applicable Federal UIC program under part 147 or as a substantial program revision to an approved State UIC program under §145.32 of this chapter and will not be final until approved by EPA.

(1) The owner or operator of a Class II enhanced oil recovery or enhanced gas recovery well that requests an expansion of the areal extent of an existing aquifer exemption for the exclusive purpose of Class VI injection for geologic sequestration must define (by narrative description, illustrations, maps, or other means) and describe in geographic and/or geometric terms (such as vertical and lateral limits and gradient) that are clear and definite, all aquifers or parts thereof that are requested to be designated as exempted using the criteria in §146.4 of this chapter.

(2) In evaluating a request to expand the areal extent of an aquifer exemption of a Class II enhanced oil recovery or enhanced gas recovery well for the purpose of Class VI injection, the Director must determine that the request meets the criteria for exemptions in §146.4. In making the determination, the Director shall consider:

(B) When the Director determines that a pattern of noncompliance exists for a major facility permittee over the most recent four consecutive reporting periods. This pattern includes any violation of the same requirement in two consecutive reporting periods, and any violation of one or more requirements in each of four consecutive reporting periods; or

(C) When the Director determines significant permit noncompliance or other significant event has occurred, such as a migration of fluids into a USDW.

(vi) *All other.* Statistical information shall be reported quarterly on all other instances of noncompliance by major facilities with permit requirements not otherwise reported under paragraph (a) of this section.

(b) *Annual reports*—(1) *Annual noncompliance report.* Statistical reports shall be submitted by the Director on nonmajor UIC permittees indicating the total number reviewed, the number of noncomplying nonmajor permittees, the number of enforcement actions, and number of permit modifications extending compliance deadlines. The statistical information shall be organized to follow the types of noncompliance listed in paragraph (a) of this section.

(2) *For State-administered UIC Programs only.* In addition to the annual noncompliance report, the State Director shall:

(i) Submit each year a program report to the Administrator (in a manner and form prescribed by the Administrator) consisting of:

(A) A detailed description of the State's implementation of its program;

(B) Suggested changes, if any to the program description (see §145.23(f)) which are necessary to reflect more accurately the State's progress in issuing permits;

(C) An updated inventory of active underground injection operations in the State.

(ii) In addition to complying with the requirements of paragraph (b)(2)(i) of this section, the Director shall provide the Administrator, on February 28th and August 31st of each of the first two years of program operation, the information required in 40 CFR 146.15, 146.25, and 146.35.

(iii) All Class VI program reports shall be consistent with reporting requirements set forth in §146.91 of this chapter.

(c) *Schedule.* (1) For all quarterly reports. On the last working day of May, August, November, and February, the State Director shall submit to the Regional Administrator information concerning noncompliance with permit requirements by major facilities in the State in accordance with the following schedule. The Regional Administrator shall prepare and submit information for EPA-issued permits to EPA Headquarters in accordance with the same schedule.

QUARTERS COVERED BY REPORTS ON NONCOMPLIANCE BY MAJOR FACILITIES

[Date for completion of reports]

January, February, and March	[1]May 31
April, May, and June	[1]Aug. 31
July, August, and September	[1]Nov. 30
October, November, and December	[1]Feb. 28

[1]Reports must be made available to the public for inspection and copying on this date.

(2) *For all annual reports.* The period for annual reports shall be for the calendar year ending December 31, with reports completed and available to the public no more than 60 days later.

[48 FR 14189, Apr. 1, 1983, as amended at 75 FR 77287, Dec. 10, 2010]

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Subpart B—General Program Requirements

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§144.11 Prohibition of unauthorized injection.

Any underground injection, except into a well authorized by rule or except as authorized by permit issued under the UIC program, is prohibited. The construction of any well required to have a permit is prohibited until the permit has been issued.

[48 FR 14189, Apr. 1, 1983, as amended at 58 FR 63895, Dec. 3, 1993]

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§144.12 Prohibition of movement of fluid into underground sources of drinking water.

(a) No owner or operator shall construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation under 40 CFR part 142 or may otherwise adversely affect the health of persons. The applicant for a permit shall have the burden of showing that the requirements of this paragraph are met.

(b) For Class I, II, III, and VI wells, if any water quality monitoring of an underground source of drinking water indicates the movement of any contaminant into the underground source of drinking water, except as authorized under part 146, the Director shall prescribe such additional requirements for construction, corrective action, operation, monitoring, or reporting (including closure of the injection well) as are necessary to prevent such movement. In the case of wells authorized by permit, these additional requirements shall be imposed by modifying the permit in accordance with §144.39, or the permit may be terminated under §144.40 if cause exists, or appropriate enforcement action may be taken if the permit has been violated. In the case of wells authorized by rule, see §§144.21 through 144.24. For EPA administered programs, such enforcement action shall be taken in accordance with appropriate sections of the SDWA.

(c) For Class V wells, if at any time the Director learns that a Class V well may cause a violation of primary drinking water regulations under 40 CFR part 142, he or she shall:

(1) Require the injector to obtain an individual permit;

(2) Order the injector to take such actions (including, where required, closure of the injection well) as may be necessary to prevent the violation. For EPA administered programs, such orders shall be issued in accordance with the appropriate provisions of the SDWA; or

(3) Take enforcement action.

(d) Whenever the Director learns that a Class V well may be otherwise adversely affecting the health of persons, he or she may prescribe such actions as may be necessary to prevent the adverse effect, including any action authorized under paragraph (c) of this section.

(e) Notwithstanding any other provision of this section, the Director may take emergency action upon receipt of information that a contaminant which is present in or likely to enter a public water system or underground source of drinking water may present an imminent and substantial endangerment to the health of persons. If the Director is an EPA official, he must first determine that the appropriate State and local authorities have not taken appropriate action to protect the health of such persons, before taking emergency action.

[48 FR 14189, Apr. 1, 1983, as amended at 52 FR 20676, June 2, 1987; 75 FR 77288, Dec. 10, 2010]

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§144.13 Prohibition of Class IV wells.

(a) The following are prohibited, except as provided in paragraph (c) of this section:

(1) The construction of any Class IV well.

(2) The operation or maintenance of any Class IV well not in operation prior to July 18, 1980.

(3) The operation or maintenance of any Class IV well that was in operation prior to July 18, 1980, after six months following the effective date of a UIC program approved or promulgated for the state.

(4) Any increase in the amount of hazardous waste or change in the type of hazardous waste injected into a Class IV well.

(b) The owner or operator of a Class IV well shall comply with the requirements of §144.14, and with the requirements of §144.23 regarding closure of Class IV wells.

(c) Wells used to inject contaminated ground water that has been treated and is being reinjected into the same formation from which it was drawn are not prohibited by this section if such injection is approved by EPA, or a State, pursuant to provisions for cleanup of releases under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 U.S.C. 9601-9657, or pursuant to requirements and provisions under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6901 through 6987.

(d) *Clarification.* The following wells are not prohibited by this action:

(1) Wells used to inject hazardous waste into aquifers or portions thereof that have been exempted pursuant to §146.4, if the exempted aquifer into which waste is injected underlies the lowermost formation containing a USDW. Such wells are Class I wells as specified in §144.6(a)(1), and the owner or operator must comply with the requirements applicable to Class I wells.

(6) Forty-eight hours after receipt of a determination by the Director pursuant to §144.28(f)(3) that the well lacks mechanical integrity, unless the Director requires immediate cessation; or

(7) Upon receipt of notification from the Director pursuant to §144.28(l) that the transferee has not demonstrated financial responsibility pursuant to §144.28(d).

(d) *Requirements.* The owner or operator of a well authorized under this section shall comply with the applicable requirements of §144.28 and part 147 of this chapter. Such owner or operator shall comply with the casing and cementing requirements no later than 3 years and other requirements no later than 1 year after authorization.

[49 FR 20181, May 11, 1984, as amended at 58 FR 63896, Dec. 3, 1993; 75 FR 77288, Dec. 10, 2010]

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§144.23 Class IV wells.

(a) Injection into existing Class IV wells is authorized for up to six months after approval or promulgation of the UIC Program. Such wells are subject to the requirements of §§144.13 and 144.14(c).

(b) *Closure.* For EPA administered programs only,

(1) Prior to abandoning any Class IV well, the owner or operator shall plug or otherwise close the well in a manner acceptable to the Regional Administrator.

(2) [Reserved]

(3) The owner or operator of a Class IV well must notify the Regional Administrator of intent to abandon the well at least thirty days prior to abandonment.

(c) Notwithstanding the requirements of paragraphs (a) and (b) of this section, injection wells used to inject contaminated ground water that has been treated and is being injected into the same formation from which it was drawn are authorized by rule for the life of the well if such subsurface emplacement of fluids is approved by EPA, or a State, pursuant to provisions for cleanup of releases under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 U.S.C. 9601-9675, or pursuant to requirements and provisions under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. 6901-6992k.

[49 FR 20181, May 11, 1984, as amended at 60 FR 33932, June 29, 1995; 64 FR 68566, Dec. 7, 1999]

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§144.24 Class V wells.

(a) A Class V injection well is authorized by rule, subject to the conditions in §144.84

(b) *Duration of well authorization by rule.* Well authorization under this section expires upon the effective date of a permit issued pursuant to §§144.25, 144.31, 144.33 or 144.34, or upon proper closure of the well.

(c) *Prohibition of injection.* An owner or operator of a well which is authorized by rule pursuant to this section is prohibited from injecting into the well:

(1) Upon the effective date of an applicable permit denial;

(2) Upon failure to submit a permit application in a timely manner pursuant to §§144.25 or 144.31;

(3) Upon failure to submit inventory information in a timely manner pursuant to §144.26; or

(4) Upon failure to comply with a request for information in a timely manner pursuant to §144.27.

[58 FR 63896, Dec. 3, 1993, as amended at 64 FR 68566, Dec. 7, 1999]

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§144.25 Requiring a permit.

(a) The Director may require the owner or operator of any Class I, II, III or V injection well which is authorized by rule under this subpart to apply for and obtain an individual or area UIC permit. Cases where individual or area UIC permits may be required include:

(1) The injection well is not in compliance with any requirement of the rule;

NOTE: Any underground injection which violates any authorization by rule is subject to appropriate enforcement action.

(2) The injection well is not or no longer is within the category of wells and types of well operations authorized in the rule;

(3) The protection of USDWs requires that the injection operation be regulated by requirements, such as for corrective action, monitoring and reporting, or operation, which are not contained in the rule.

(4) When the injection well is a Class I, II (except existing enhanced recovery and hydrocarbon storage) or III well, in accordance with a schedule established by the Director pursuant to §144.31(c).

(b) For EPA-administered programs, the Regional Administrator may require an owner or operator of any well which is authorized by rule under this subpart to apply for an individual or area UIC permit under this paragraph only if the owner or operator has been notified in writing that a permit application is required. The owner or operator of a well which is authorized by rule under this subpart is prohibited from injecting into the well upon the effective date of permit denial, or upon failure by the owner or operator to submit an application in a timely manner as specified in the notice. The notice shall include: a brief statement of the reasons for requiring a permit; an application form; a statement setting a time for the owner or operator to file the application; and a statement of the consequences of denial or issuance of the permit, or failure to submit an application, as described in this paragraph.

(c) An owner or operator of a well authorized by rule may request to be excluded from the coverage of this subpart by applying for an individual or area UIC permit. The owner or operator shall submit an application under §144.31 with reasons supporting the request, to the Director. The Director may grant any such requests.

[48 FR 14189, Apr. 1, 1983, as amended at 49 FR 20182, May 11, 1984; 58 FR 63896, Dec. 3, 1993]

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§144.26 Inventory requirements.

The owner or operator of an injection well which is authorized by rule under this subpart shall submit inventory information to the Director. Such an owner or operator is prohibited from injecting into the well upon failure to submit inventory information for the well within the time frame specified in paragraph (d) of this section.

(a) *Contents.* As part of the inventory, the Director shall require and the owner/operator shall provide at least the following information:

(1) Facility name and location;

(2) Name and address of legal contact;

(3) Ownership of facility;

(4) Nature and type of injection wells; and

(5) Operating status of injection wells.

NOTE: This information is requested on national form "Inventory of Injection Wells," OMB No. 158-R0170.

(b) *Additional contents.* For EPA administered programs only, the owner or operator of a well listed in paragraph (b)(1) of this section shall provide the information listed in paragraph (b)(2) of this section.

(1) This section applies to the following wells:

(i) Class II enhanced recovery wells;

(ii) Class IV wells;

(iii) The following Class V wells:

(A) Sand or other backfill wells [§146.5(e)(8)];

(B) Radioactive waste disposal wells that are not Class I wells (40 CFR 146.5 (e)(11))

(C) Geothermal energy recovery wells [§146.5(e)(12)];

(D) Brine return flow wells [§146.5(e)(14)];

(E) Wells used in experimental technologies [§146.5(e)(15)];

(F) Municipal and industrial disposal wells other than Class I; and

(G) Any other Class V wells at the discretion of the Regional Administrator.

(2) The owner or operator of a well listed in paragraph (b)(1) shall provide a listing of all wells owned or operated setting forth the following information for each well. (A single description of wells at a single facility with substantially the same characteristics is acceptable).

(i) For Class II only, the field name(s);

(ii) Location of each well or project given by Township, Range, Section, and Quarter-Section, or by latitude and longitude to the nearest second, according to the conventional practice in the State;

(iii) Date of completion of each well;

(iv) Identification and depth of the formation(s) into which each well is injecting;

(v) Total depth of each well;

(vi) Casing and cementing record, tubing size, and depth of packer;

(vii) Nature of the injected fluids;

(viii) Average and maximum injection pressure at the wellhead;

(ix) Average and maximum injection rate; and

(x) Date of the last mechanical integrity test, if any.

(c) *Notice.* Upon approval of the UIC Program in a State, the Director shall notify owners or operators of injection wells of their duty to submit inventory information. The method of notification selected by the Director must assure that the owners or operators will be made aware of the inventory requirement.

(d) *Deadlines.* (1) The owner or operator of an injection well shall submit inventory information no later than one year after the date of approval or effective date of the UIC program for the State. The Director need not require inventory information from any facility with interim status under RCRA.

(2) For EPA administered programs the information need not be submitted if a complete permit application is submitted within one year of the effective data of the UIC program. The owner or operator of Class IV well shall submit inventory information no later than 60 days after the effective date of the program.

[48 FR 14189, Apr. 1, 1983, as amended at 49 FR 20182, May 11, 1984; 58 FR 63896, Dec. 3, 1993; 64 FR 68566, Dec. 7, 1999; 67 FR 39593, June 7, 2002]

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§144.27 Requiring other information.

(a) For EPA administered programs only, in addition to the inventory requirements of §144.26, the Regional Administrator may require the owner or operator of any well authorized by rule under this subpart to submit information as deemed necessary by the Regional Administrator to determine whether a well may be endangering an underground source of drinking water in violation of §144.12 of this part.

(b) Such information requirements may include, but are not limited to:

(1) Performance of ground-water monitoring and the periodic submission of reports of such monitoring;

(2) An analysis of injected fluids, including periodic submission of such analyses; and

(3) A description of the geologic strata through and into which injection is taking place.

(c) Any request for information under this section shall be made in writing, and include a brief statement of the reasons for requiring the information. An owner or operator shall submit the information within the time period(s) provided in the notice.

(d) An owner or operator of an injection well authorized by rule under this subpart is prohibited from injecting into the well upon failure of the owner or operator to comply with a request for information within the time period(s) specified by the Director pursuant to paragraph (c) of this section. An owner or operator of a well prohibited from injection under this section shall not resume injection except under a permit issued pursuant to §§144.25, 144.31, 144.33 or 144.34.

[49 FR 20182, May 11, 1984, as amended at 58 FR 63896, Dec. 3, 1993]

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§144.28 Requirements for Class I, II, and III wells authorized by rule.

3. “Plugging and abandonment plan” as used below refers to the plans maintained as required by 40 CFR part 144 for the plugging and abandonment of injection wells as identified above.

4. For value received from [owner or operator], guarantor guarantees to EPA that in the event that [owner or operator] fails to perform [“plugging and abandonment”] of the above facility(ies) in accordance with the plugging and abandonment plan and other requirements when required to do so, the guarantor will do so or fund a trust fund as specified in 40 CFR 144.63 in the name of [owner or operator] in the amount of the adjusted plugging and abandonment cost estimates prepared as specified in 40 CFR 144.62.

5. Guarantor agrees that, if at the end of any fiscal year before termination of this guarantee, the guarantor fails to meet the financial test criteria, guarantor will send within 90 days, by certified mail, notice to the EPA Regional Administrator(s) for the Region (s) in which the facility(ies) is (are) located and to [owner or operator] that he intends to provide alternate financial assurance as specified in 40 CFR 144.63 in the name of [owner or operator]. Within 30 days after sending such notice, the guarantor will establish such financial assurance if [owner or operator] has not done so.

6. The guarantor agrees to notify the Regional Administrator, by certified mail, of a voluntary or involuntary case under Title 11, U.S. Code, naming guarantor as debtor, within 10 days after its commencement.

7. Guarantor agrees that within 30 days after being notified by an EPA Regional Administrator of a determination that guarantor no longer meets the financial test criteria or that he is disallowed from continuing as a guarantor of plugging and adandonment, he will establish alternate financial assurance, as specified in 40 CFR 144.63, in the name of [owner or operator] if [owner or operator] has not done so.

8. Guarantor agrees to remain bound under this guarantee notwithstanding any or all of the following: amendment or modification of the plugging and abandonment plan, the extension or reduction of the time of performance of plugging and abandonment or any other modification or alteration of an obligation of [owner or operator] pursuant to 40 CFR part 144.

9. Guarantor agrees to remain bound under this guarantee for so long as [owner or operator] must comply with the applicable financial assurance requirements of 40 CFR part 144 for the above-listed facilities, except that guarantor may cancel this guarantee by sending notice by certified mail, to the EPA Regional Administrator(s) for the Region(s) in which the facility(ies) is (are) located and to [owner or operator], such cancellation to become effective no earlier than 120 days after actual receipt of such notice by both EPA and [owner or operator] as evidenced by the return receipts.

10. Guarantor agrees that if [owner or operator] fails to provide alternate financial assurance and obtain written approval of such assurance from the EPA Regional Administrator(s) within 90 days after a notice of cancellation by the guarantor is received by both the EPA Regional Administrator(s) and [owner or operator], guarantor will provide alternate financial assurance as specified in 40 CFR 144.63 in the name of [owner or operator].

11. Guarantor expressly waives notice of acceptance of this guarantee by the EPA or by [owner or operator]. Guarantor also expressly waives notice of amendments or modifications of the plugging and abandonment plan.

I hereby certify that the wording of this guarantee is identical to the wording specified in 40 CFR 144.70(f).

Effective date: ___.

[Name of guarantor]

[Authorized signature for guarantor]

[Type name of person signing]

[Title of person signing]

Signature of witness or notary: ___

[48 FR 14189, Apr. 1, 1983, as amended at 59 FR 29959, June 10, 1994]

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Subpart G—Requirements for Owners and Operators of Class V Injection Wells

SOURCE: 64 FR 68566, Dec. 7, 1999, unless otherwise noted.

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§144.79 General.

This subpart tells you what requirements apply if you own or operate a Class V injection well. You may also be required to follow additional requirements listed in the rest of this part. Where they may apply, these other requirements are referenced rather than repeated. The requirements described in this subpart and elsewhere in this part are to protect underground sources of drinking water and are part of the Underground Injection Control (UIC) Program established under the Safe Drinking Water Act. This subpart is written in a special format to make it easier to understand the regulatory requirements. Like other EPA regulations, it establishes enforceable legal requirements.

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DEFINITION OF CLASS V INJECTION WELLS

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§144.80 What is a Class V injection well?

As described in §144.6, injection wells are classified as follows:

(a) *Class I.* (1) Wells used by generators of hazardous waste or owners or operators of hazardous waste management facilities to inject hazardous waste beneath the lowermost formation containing, within one-quarter mile of the well bore, an underground source of drinking water.

(2) Other industrial and municipal disposal wells which inject fluids beneath the lowermost formation containing, within one quarter mile of the well bore, an underground source of drinking water;

(3) Radioactive waste disposal wells which inject fluids below the lowermost formation containing an underground source of drinking water within one quarter mile of the well bore.

(b) *Class II.* Wells which inject fluids:

(1) Which are brought to the surface in connection with natural gas storage operations, or conventional oil or natural gas production and may be commingled with waste waters from gas plants which are an integral part of production operations, unless those waters are classified as a hazardous waste at the time of injection.

(2) For enhanced recovery of oil or natural gas; and

(3) For storage of hydrocarbons which are liquid at standard temperature and pressure.

(c) *Class III.* Wells which inject fluids for extraction of minerals including:

(1) Mining of sulfur by the Frasch process;

(2) *In situ* production of uranium or other metals; this category includes only in situ production from ore bodies which have not been conventionally mined. Solution mining of conventional mines such as stopes leaching is included in Class V.

(3) Solution mining of salts or potash.

(d) *Class IV.* (1) Wells used by generators of hazardous waste or of radioactive waste, by owners and operators of hazardous waste management facilities, or by owners or operators of radioactive waste disposal sites to dispose of hazardous waste or radioactive waste into a formation which within one quarter ($\frac{1}{4}$) mile of the well contains an underground source of drinking water.

(2) Wells used by generators of hazardous waste or of radioactive waste, by owners and operators of hazardous waste management facilities, or by owners or operators of radioactive waste disposal sites to dispose of hazardous waste or radioactive waste above a formation which within one quarter ($\frac{1}{4}$) mile of the well contains an underground source of drinking water.

(3) Wells used by generators of hazardous waste or owners or operators of hazardous waste management facilities to dispose of hazardous waste, which cannot be classified under paragraph (a)(1) or (d)(1) and (2) of this section (e.g., wells used to dispose of hazardous waste into or above a formation which contains an aquifer which has been exempted pursuant to 40 CFR 146.04).

(e) *Class V.* Injection wells not included in Class I, II, III, IV or VI. Typically, Class V wells are shallow wells used to place a variety of fluids directly below the land surface. However, if the fluids you place in the ground qualify as a hazardous waste under the Resource Conservation and Recovery Act (RCRA), your well is either a Class I or Class IV well, not a Class V well. Examples of Class V wells are described in §144.81.

(f) *Class VI.* Wells used for geologic sequestration of carbon dioxide beneath the lowermost formation containing a USDW, except those wells that are experimental in nature; or, wells used for geologic sequestration of carbon dioxide that have been granted a waiver of the injection depth requirements pursuant to requirements at §146.95 of this chapter; or, wells used for geologic sequestration of carbon dioxide that have received an expansion to the areal extent of a existing Class II enhanced oil recovery or enhanced gas recovery aquifer exemption pursuant to §146.4 of this chapter and §144.7 (d).

[64 FR 68566, Dec. 7, 1999, as amended at 75 FR 77290, Dec. 10, 2010]

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§144.81 Does this subpart apply to me?

This subpart applies to you if you own or operate a Class V well, for example:

(1) Air conditioning return flow wells used to return to the supply aquifer the water used for heating or cooling in a heat pump;

(2) Large capacity cesspools including multiple dwelling, community or regional cesspools, or other devices that receive sanitary wastes, containing human excreta, which have an open bottom and sometimes perforated sides. The UIC requirements do not apply to single family residential cesspools nor to non-residential cesspools which receive solely sanitary waste and have the capacity to serve fewer than 20 persons a day.

(3) Cooling water return flow wells used to inject water previously used for cooling;

(4) Drainage wells used to drain surface fluids, primarily storm runoff, into a subsurface formation;

(5) Dry wells used for the injection of wastes into a subsurface formation;

(6) Recharge wells used to replenish the water in an aquifer;

(7) Salt water intrusion barrier wells used to inject water into a fresh aquifer to prevent the intrusion of salt water into the fresh water;

(8) Sand backfill and other backfill wells used to inject a mixture of water and sand, mill tailings or other solids into mined out portions of subsurface mines whether what is injected is a radioactive waste or not.

(9) Septic system wells used to inject the waste or effluent from a multiple dwelling, business establishment, community or regional business establishment septic tank. The UIC requirements do not apply to single family residential septic system wells, nor to non-residential septic system wells which are used solely for the disposal of sanitary waste and have the capacity to serve fewer than 20 persons a day.

(10) Subsidence control wells (not used for the purpose of oil or natural gas production) used to inject fluids into a non-oil or gas producing zone to reduce or eliminate subsidence associated with the overdraft of fresh water;

(11) Injection wells associated with the recovery of geothermal energy for heating, aquaculture and production of electric power;

(12) Wells used for solution mining of conventional mines such as stopes leaching;

(13) Wells used to inject spent brine into the same formation from which it was withdrawn after extraction of halogens or their salts;

(14) Injection wells used in experimental technologies.

(15) Injection wells used for in situ recovery of lignite, coal, tar sands, and oil shale.

(16) Motor vehicle waste disposal wells that receive or have received fluids from vehicular repair or maintenance activities, such as an auto body repair shop, automotive repair shop, new and used car dealership, specialty repair shop (e.g., transmission and muffler repair shop), or any facility that does any vehicular repair work. Fluids disposed in these wells may contain organic and inorganic chemicals in concentrations that exceed the maximum contaminant levels (MCLs) established by the primary drinking water regulations (see 40 CFR part 141). These fluids also may include waste petroleum products and may contain contaminants, such as heavy metals and volatile organic compounds, which pose risks to human health.

[64 FR 68566, Dec. 7, 1999, as amended at 67 FR 39593, June 7, 2002]

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Requirements for All Class V Injection Wells

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§144.82 What must I do to protect underground sources of drinking water?

If you own or operate any type of Class V well, the regulations below require that you cannot allow movement of fluid into USDWs that might cause endangerment, you must comply with other Federal UIC requirements in 40 CFR parts 144 through 147, and you must comply with any other measures required by your State or EPA Regional Office UIC Program to protect USDWs, and you must properly close your well when you are through using it. You also must submit basic information about your well, as described in §144.83.

(a) *Prohibition of fluid movement.* (1) As described in §144.12(a), your injection activity cannot allow the movement of fluid containing any contaminant into USDWs, if the presence of that contaminant may cause a violation of the primary drinking water standards under 40 CFR part 141, other health based standards, or may otherwise adversely affect the health of persons. This prohibition applies to your well construction, operation, maintenance, conversion, plugging, closure, or any other injection activity.

(2) If the Director of the UIC Program in your State or EPA Region learns that your injection activity may endanger USDWs, he or she may require you to close your well, require you to get a permit, or require other actions listed in §144.12(c), (d), or (e).

(b) *Closure requirements.* You must close the well in a manner that complies with the above prohibition of fluid movement. Also, you must dispose or otherwise manage any soil, gravel, sludge, liquids, or other materials removed from or adjacent to your well in accordance with all applicable Federal, State, and local regulations and requirements.

(c) *Other requirements in Parts 144 through 147.* Beyond this subpart, you are subject to other UIC Program requirements in 40 CFR parts 144 through 147. While most of the relevant requirements are repeated or referenced in this subpart for convenience, you need to read these other parts to understand the entire UIC Program.

(d) *Other State or EPA requirements.* 40 CFR parts 144 through 147 define minimum Federal UIC requirements. EPA Regional Offices administering the UIC Program have the flexibility to establish additional or more stringent requirements based on the authorities in parts 144 through 147, if believed to be necessary to protect USDWs. States can have their own authorities to establish additional or more stringent requirements if needed to protect USDWs. You must comply with these additional requirements, if any exist in your area. Contact the UIC Program Director in your State or EPA Region to learn more.

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§144.83 Do I need to notify anyone about my Class V injection well?

Yes, you need to provide basic "inventory information" about your well to the UIC Director, if you haven't already. You also need to provide any additional information that your UIC Program Director requests in accordance with the provisions of the UIC regulations.

(a) *Inventory requirements.* Unless you know you have already satisfied the inventory requirements in §144.26 that were in effect prior to the issuance of this Subpart G, you must give your UIC Program Director certain information about yourself and your injection operation.

NOTE: This information is requested on national form "Inventory of Injection Wells," OMB No. 2040-0042.

(1) The requirements differ depending on your well status and location, as described in the following table:

If your well is . . .	And you're in one of these locations ("Primacy" States, where the State runs the Class V UIC Program): Alabama, Arkansas, Commonwealth of Northern Mariana Islands, Connecticut, Delaware, Florida, Georgia, Guam, Idaho, Illinois, Kansas, Louisiana, Maine, Maryland, Massachusetts, Mississippi, Missouri, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Puerto Rico, Rhode Island, South Carolina, Texas, Utah, Vermont, Washington, West Virginia, Wisconsin, or Wyoming	Or you're in one of these locations ("Direct Implementation" or DI Programs, where EPA runs the Class V UIC Program): Alaska, American Samoa, Arizona, California, Colorado, Hawaii, Indiana, Iowa, Kentucky, Michigan, Minnesota, Montana, New York, Pennsylvania, South Dakota, Tennessee, Virginia, Virgin Islands, Washington, DC, or any Indian Country
(i) New (prior to construction of your well)	. . . then you must contact your State UIC Program to determine what you must submit and by when.	. . . then you must submit the inventory information described in (a)(2) of this section prior to constructing your well.
(ii) Existing (construction underway or completed)	. . . then you must contact your State UIC Program to determine what you must submit and by when.	. . . then you must cease injection and submit the inventory information. You may resume injection 90 days after you submit the information unless the UIC Program Director notifies you that injection may not resume or may resume sooner.

(2) If your well is in a Primacy State or a DI Program State, here is the information you must submit:

(i) No matter what type of Class V well you own or operate, you must submit at least the following information for each Class V well: facility name and location; name and address of legal contact; ownership of facility; nature and type of injection well(s); and operating status of injection well(s).

(ii) *Additional information.* If you are in a Direct Implementation State and you own or operate a well listed below you must also provide the information listed in paragraph (a) (2) (iii) as follows:

(A) Sand or other backfill wells (40 CFR 144.81(8) and 146.5(e)(8) of this chapter);

(B) Geothermal energy recovery wells (40 CFR 144.81(11) and 146.5 (e)(12) of this chapter);

(C) Brine return flow wells (40 CFR 144.81(13) and 146.5 (e)(14) of this chapter);

(D) Wells used in experimental technology (40 CFR 144.81(14) and 146.5 (e)(15) of this chapter);

(E) Municipal and industrial disposal wells other than Class I; and

(F) Any other Class V wells at the discretion of the Regional Administrator.

(iii) You must provide a list of all wells owned or operated along with the following information for each well. (A single description of wells at a single facility with substantially the same characteristics is acceptable).

(A) Location of each well or project given by Township, Range, Section, and Quarter-Section, or by latitude and longitude to the nearest second, according to the conventional practice in your State;

(B) Date of completion of each well;

(C) Identification and depth of the underground formation(s) into which each well is injecting;

(D) Total depth of each well;

(E) Construction narrative and schematic (both plan view and cross-sectional drawings);

(F) Nature of the injected fluids;

(G) Average and maximum injection pressure at the wellhead;

(H) Average and maximum injection rate; and

(I) Date of the last inspection.

(3) Regardless of whether your well is in a Primacy State or DI Program you are responsible for knowing about, understanding, and complying with these inventory requirements.

(b) *Information in response to requests.* If you are in one of the DI Programs listed in the table above, the UIC Program Director may require you to submit other information believed necessary to protect underground sources of drinking water.

(1) Such information requirements may include, but are not limited to:

(i) Perform ground water monitoring and periodically submit your monitoring results;

(ii) Analyze the fluids you inject and periodically submit the results of your analyses;

(iii) Describe the geologic layers through which and into which you are injecting; and

(iv) Conduct other analyses and submit other information, if needed to protect underground sources of drinking water.

(2) If the Director requires this other information, he or she will request it from you in writing, along with a brief statement on why the information is required. This written notification also will tell you when to submit the information.

(3) You are prohibited from using your injection well if you fail to comply with the written request within the time frame specified. You can start injecting again only if you receive a permit.

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§144.84 Do I need to get a permit?

No, unless you fall within an exception described below:

(a) *General authorization by rule.* With certain exceptions listed in paragraph (b) of this section, your Class V injection activity is “authorized by rule,” meaning you have to comply with all the requirements of this subpart and the rest of the UIC Program but you don't have to get an individual permit. Well authorization expires once you have properly closed your well, as described in §144.82(b).

(b) *Circumstances in which permits or other actions are required.* If you fit into one of the categories listed below, your Class V well is no longer authorized by rule. This means that you have to either get a permit or close your injection well. You can find out by contacting the UIC Program Director in your State or EPA Region if this is the case. Subpart D of this part tells you how to apply for a permit and describes other aspects of the permitting process. Subpart E of this part outlines some of the requirements that apply to you if you get a permit.

(1) You fail to comply with the prohibition of fluid movement standard in §144.12(a) and described in §144.82(a) (in which case, you have to get a permit, close your well, and/or comply with other conditions determined by the UIC Program Director in your State or EPA Region);

(2) You own or operate a Class V large-capacity cesspool (in which case, you must close your well as specified in the additional requirements below) or a Class V motor vehicle waste disposal well in a ground water protection area or sensitive ground water area (in which case, you must either close your well or get a permit as specified in the additional requirements in this subsection). New motor vehicle waste disposal wells and new cesspools are prohibited as of April 5, 2000;

(3) You are specifically required by the UIC Program Director in your State or EPA Region to get a permit (in which case, rule authorization expires upon the effective date of the permit issued, or you are prohibited from injecting into your well upon:

(i) Failure to submit a permit application in a timely manner as specified in a notice from the Director; or

(ii) Upon the effective date of permit denial);

(4) You have failed to submit inventory information to your UIC Program Director, as described in §144.83(a) (in which case, you are prohibited from injecting into your well until you comply with the inventory requirements); or

(5) If you are in a DI State and you received a request from your UIC Program Director for additional information under §144.83(b), and have failed to comply with the request in a timely manner (in which case, you are prohibited from injecting into your well until you get a permit).

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Additional Requirements for Class V Large-Capacity Cesspools and Motor Vehicle Waste Disposal Wells

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§144.85 Do these additional requirements apply to me?

(a) *Large-capacity cesspools.* The additional requirements apply to all new and existing large-capacity cesspools regardless of their location. If you are using a septic system for these type of wastes you are not subject to the additional requirements in this subpart.

(b) *Motor vehicle waste disposal wells existing on April 5, 2000.* If you have a Class V motor vehicle waste disposal well these requirements apply to you if your well is located in a ground water protection area or other sensitive ground water area that is identified by your State or EPA Region. If your State or EPA Region fails to identify ground water protection areas and/or other sensitive ground water areas these requirements apply to all Class V motor vehicle wells in the State.

(c) *New motor vehicle waste disposal wells.* The additional requirements apply to all new motor vehicle waste disposal wells as of April 5, 2000.

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§144.86 What are the definitions I need to know?

(a) *State Drinking Water Source Assessment and Protection Program.* This is a new approach to protecting drinking water sources, specified in the 1996 Amendments to the Safe Drinking Water Act at Section 1453. States must prepare and submit for EPA approval a program that sets out how States will conduct local assessments, including: delineating the boundaries of areas providing source waters for public water systems; identifying significant potential sources of contaminants in such areas; and determining the susceptibility of public water systems in the delineated areas to the inventoried sources of contamination.

(b) *Complete local source water assessment for ground water protection areas.* When EPA has approved a State's Drinking Water Source Assessment and Protection Program, States will begin to conduct local assessments for each public water system in their State. For the purposes of this rule, local assessments for community water systems and non-transient non-community systems are complete when four requirements are met: First, a State must delineate the boundaries of the assessment area for community and non-transient non-community water systems. Second, the State must identify significant potential sources of contamination in these delineated areas. Third, the State must “determine the susceptibility of community and non-transient non-community water systems in the delineated area to such contaminants.” Lastly, each State will develop its own plan for making the completed assessments available to the public.

(c) *Ground water protection area.* A ground water protection area is a geographic area near and/or surrounding community and non-transient non-community water systems that use ground water as a source of drinking water. These areas receive priority for the protection of drinking water supplies and States are required to delineate and assess these areas under section 1453 of the Safe Drinking Water Act. The additional requirements in §144.88 apply to you if your Class V motor vehicle waste disposal well is in a ground water protection area for either a community water system or a non-transient non-community water system, in many States, these areas will be the same as Wellhead Protection Areas that have been or will be delineated as defined in section 1428 of the SDWA.

(d) *Community water system.* A community water system is a public water system that serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

(e) *Non-transient non-community water system.* A public water system that is not a community water system and that regularly serves at least 25 of the same people over six months a year. These may include systems that provide water to schools, day care centers, government/military installations, manufacturers, hospitals or nursing homes, office buildings, and other facilities.

(f) *Delineation.* Once a State's Drinking Water Source Assessment and Protection Program is approved, the States will begin delineating their local assessment areas. Delineation is the first step in the assessment process in which the boundaries of ground water protection areas are identified.

(g) *Other sensitive ground water areas.* States may also identify other areas in the State in addition to ground water protection areas that are critical to protecting underground sources of drinking water from contamination. These other sensitive ground water areas may include areas such as areas overlying sole-source aquifers; highly productive aquifers supplying private wells; continuous and highly productive aquifers at points distant from public water supply wells; areas where water supply aquifers are recharged; karst aquifers that discharge to surface reservoirs serving as public water supplies; vulnerable or sensitive hydrogeologic settings, such as glacial outwash deposits, eolian sands, and fractured volcanic rock; and areas of special concern selected based on a combination of factors, such as hydrogeologic sensitivity, depth to ground water, significance as a drinking water source, and prevailing land-use practices.

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§144.87 How does the identification of ground water protection areas and other sensitive ground water areas affect me?

(a) You are subject to these new requirements if you own or operate an existing motor vehicle well and you are located in a ground water protection area or an other sensitive ground water area. If your State or EPA Region fails to identify these areas within the specified time frames these requirements apply to all existing motor vehicle waste disposal wells within your State.

(b) *Ground water protection areas.* (1) For the purpose of this subpart, States are required to complete all local source water assessments for ground water protection areas by January 1, 2004. Once a local assessment for a ground water protection area is complete every existing motor vehicle waste disposal well owner in that ground water protection area has one year to close the well or receive a permit. If a State fails to complete all local assessments for ground water protection areas by January 1, 2004, the following may occur:

(i) The new requirements in this subpart will apply to all existing motor vehicle waste disposal wells in the State and owners and operators of motor vehicle waste disposal wells located outside of completed assessments for ground water protection areas must close their well or receive a permit by January 1, 2005.

(ii) EPA may grant a State an extension for up to one year from the January 1, 2004 deadline if the State is making reasonable progress in completing the source water assessments for ground water protection areas. States must apply for the extension by June 1, 2003. If a State fails to complete the assessments for the remaining ground water protection areas by the extended date the rule requirements will apply to all motor vehicle waste disposal wells in the State and owners and operators of motor vehicle waste disposal wells located outside of ground water protection areas with completed assessments must close their well or receive a permit by January 1, 2006.

(2) The UIC Program Director may extend the compliance deadline for specific motor vehicle waste disposal wells for up to one year if the most efficient compliance option for the well is connection to a sanitary sewer or installation of new treatment technology.

(c) *Other sensitive ground water areas.* States may also delineate other sensitive ground water areas by January 1, 2004. Existing motor vehicle waste disposal well owners and operators within other sensitive ground water areas have until January 1, 2007 to receive a permit or close the well. If a State or EPA Region fails to identify these additional sensitive ground water areas by January 1, 2004, the new requirements of this rule will apply to all motor vehicle waste disposal wells in the State effective January 1, 2007 unless they are subject to a different compliance date pursuant to paragraph (b) of this section. Again, EPA may extend the January 1, 2004 deadline for up to one year for States to delineate other sensitive ground water areas if the State is making reasonable progress in identifying the sensitive areas. States must apply for this extension by June 1, 2003. If a State has been granted an extension, existing motor vehicle waste disposal well owners and operators within the sensitive ground water areas have until January 1, 2008 to close the well or receive a permit, unless they are subject to a different compliance date pursuant to paragraph (b) of this section. If a State has been granted an extension and fails to delineate sensitive areas by the extended date, the rule requirements will apply to all motor vehicle waste disposal wells in the State and owners and operators have until January 1, 2008 to close the well or receive a permit, unless they are subject to a different compliance date pursuant to paragraph (b) of this section.

(d) *How to find out if your well is in a ground water protection area or sensitive ground water area.* States are required to make their local source water assessments widely available to the public through a variety of methods after the assessments are complete. You can find out if your Class V well is in a ground water protection area by contacting the State agency responsible for the State Drinking Water Source Assessment and Protection Program in your area. You may call the Safe Drinking Water Hotline at 1-800-426-4791 to find out who to call in your State for this information. The State office responsible for implementing the Drinking Water Source Assessment and Protection Program makes the final and official determination of boundaries for ground water protection areas. Because States that choose to delineate other sensitive ground water areas are also required to make the information on these areas accessible to the public, they may do so in a manner similar to the process used by the States in publicizing the EPA approved Drinking Water Source Assessment and Protection Program. You can find out if your Class V well is in an other sensitive ground water area by contacting the State or Federal agency responsible for the Underground Injection Control Program. You may call the Safe Drinking Water Hotline at 1-800-426-4791 to find out who to call for information.

(e) *Changes in the status of the EPA approved state drinking water source assessment and protection program.* After January 1, 2004 your State may assess a ground water protection area for ground water supplying a new community water system or a new non-transient non-community water system that includes your Class V injection well. Also, your State may officially re-delineate the boundaries of a previously delineated ground water protection area to include additional areas that includes your motor vehicle waste disposal well. This would make the additional regulations apply to you if your motor vehicle waste disposal well is in such an area. The additional regulations start applying to you one year after the State completes the local assessment for the ground water protection area for the new drinking water system or the new re-delineated area. The UIC Program Director responsible for your area may extend this deadline for up to one year if the most efficient compliance option for the well is connection to a sanitary sewer or installation of new treatment technology.

(f) *What happens if my state doesn't designate other sensitive ground water areas?* If your State or EPA Region elects not to delineate the additional sensitive ground water areas, the additional regulations apply to you regardless of the location of your well by January 1, 2007, or January 2008 if an extension has been granted as explained in paragraph (c) of this section, except for wells in ground water protection areas which are subject to different compliance deadlines explained in paragraph (b) of this section.

(g) [Reserved]

(h) *Application of requirements outside of ground water protection areas and sensitive ground water areas.* EPA expects and strongly encourages States to use existing authorities in the UIC program to take whatever measures are needed to ensure Class V wells are not endangering USDWs in any other areas outside of delineated ground water protection areas and sensitive ground water areas. Such measures could include, if believed to be necessary by a UIC Program Director, applying the additional requirements below to other areas and/or other types of Class V wells. Therefore, the Director may apply the additional requirements to you, even if you are not located in the areas listed in paragraph (a) of this section.

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§144.88 What are the additional requirements?

The additional requirements are specified in the following tables:

(a) TABLE 1—ADDITIONAL REQUIREMENTS FOR LARGE-CAPACITY CESSPOOLS STATEWIDE

[See §144.85 to determine if these additional requirements apply to you]

Well Status	Requirement	Deadline
If your cesspool is. . .	Then you. . .	By. . .
(1) Existing (operational or under construction by April 5, 2000)	(i) Must close the well	April 5, 2005.
	(ii) Must notify the UIC Program Director (both Primacy States and Direct Implementation States) of your intent to close the well. Note: This information is requested on national form "Preclosure Notification for Closure of Injection Wells,"	At least 30 days prior to closure.
(2) New or converted (construction not started before April 5, 2000)	Are prohibited	April 5, 2000.

(b) TABLE 2—ADDITIONAL REQUIREMENTS FOR MOTOR VEHICLE WASTE DISPOSAL WELLS

[See §144.85 to determine if these additional requirements apply to you]

Well status	Requirement	Deadline
If your motor vehicle waste disposal well is	Then. . .	By. . .
(1) Existing (operational or under construction by April 5, 2000)	(i) If your well is in a ground water protection area, you must close the well or obtain a permit	Within 1 year of the completion of your local source water assessment; your UIC Program Director may extend the closure deadline, but not the permit application deadline, for up to one year if the most efficient compliance option is connection to a sanitary sewer or installation of new treatment technology.

	(ii) If your well is in an other sensitive ground water area, you must close the well or obtain a permit	By January 1, 2007; your UIC Program Director may extend the closure deadline, but not the permit application deadline, for up to one year if the most efficient compliance option is connection to a sanitary sewer or installation of new treatment technology.
	(iii) If you plan to seek a waiver from the ban and apply for a permit, you must meet MCLs at the point of injection while your permit application is under review, if you choose to keep operating your well	The date you submit your permit application.
	(iv) If you receive a permit, you must comply with all permit conditions, if you choose to keep operating your well, including requirements to meet MCLs and other health based standards at the point of injection, follow best management practices, and monitor your injectate and sludge quality	The date(s) specified in your permit.
	(v) If your well is in a State which has not completed all their local assessments by January 1, 2004 or by the extended date if your State has obtained an extension as described in 144.87, and you are outside an area with a completed assessment you must close the well or obtain a permit	January 1, 2005 unless your State obtains an extension as described in 144.87 (b) in which case your deadline is January 1, 2006; your UIC Program Director may extend the closure deadline, but not the permit application deadline, for up to one year if the most efficient compliance option is connection to a sanitary sewer or installation of new treatment technology.
	(vi) If your well is in a State that has not delineated other sensitive ground water areas by January 1, 2004 and you are outside of an area with a completed assessment you must close the well or obtain a permit regardless of your location	January 1, 2007 unless your State obtains an extension as described in 144.87(c) in which case your deadline is January 2008.
	(vii) If you plan to close your well, you must notify the UIC Program Director of your intent to close the well (this includes closing your well prior to conversion) Note: This information is requested on national form "Preclosure Notification for Closure of Injection Wells".	At least 30 days prior to closure.
(2) New or converted (construction not started before April 5, 2000)	Are prohibited	April 5, 2000.

[64 FR 68566, Dec. 7, 1999; 64 FR 70316, Dec. 16, 1999]

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§144.89 How do I close my Class V injection well?

The following describes the requirements for closing your Class V injection well.

(a) *Closure.* (1) Prior to closing a Class V large-capacity cesspool or motor vehicle waste disposal well, you must plug or otherwise close the well in a manner that complies with the prohibition of fluid movement standard in §144.12 and summarized in §144.82(a). If the UIC Program Director in your State or EPA Region has any additional or more specific closure standards, you have to meet those standards too. You also must dispose or otherwise manage any soil, gravel, sludge, liquids, or other materials removed from or adjacent to your well in accordance with all applicable Federal, State, and local regulations and requirements, as in §144.82(b).

(2) Closure does not mean that you need to cease operations at your facility, only that you need to close your well. A number of alternatives are available for disposing of waste fluids. Examples of alternatives that may be available to motor vehicle stations include: recycling and reusing wastewater as much as possible; collecting and recycling petroleum-based fluids, coolants, and battery acids drained from vehicles; washing parts in a self-contained, recirculating solvent sink, with spent solvents being recovered and replaced by the supplier; using absorbents to clean up minor leaks and spills, and placing the used materials in approved waste containers and disposing of them properly; using a wet vacuum or mop to pick up accumulated rain or snow melt, and if allowed, connecting floor drains to a municipal sewer system or holding tank, and if allowed, disposing of the holding tank contents through a publicly owned treatment works. You should check with the publicly owned treatment works you might use to see if they would accept your wastes. Alternatives that may be available to owners and operators of a large-capacity cesspool include: conversion to a septic system; connection to sewer; and installation of an on-site treatment unit.

(b) *Conversions.* In limited cases, the UIC Director may authorize the conversion (reclassification) of a motor vehicle waste disposal well to another type of Class V well. Motor vehicle wells may only be converted if: all motor vehicle fluids are segregated by physical barriers and are not allowed to enter the well; and, injection of motor vehicle waste is unlikely based on a facility's compliance history and records showing proper waste disposal. The use of a semi-permanent plug as the means to segregate waste is not sufficient to convert a motor vehicle waste disposal well to another type of Class V well.

[64 FR 68566, Dec. 7, 1999; 65 FR 5024, Feb. 2, 2000]

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National Primary Drinking Water Regulations

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
OC	Acrylamide	TT[4]	Nervous system or blood problems; increased risk of cancer	Added to water during sewage/ wastewater treatment	zero
OC	Alachlor	0.002	Eye, liver, kidney or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops	zero
R	Alpha/photon emitters	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation	zero
IOC	Antimony	0.006	Increase in blood cholesterol; decrease in blood sugar	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder	0.006
IOC	Arsenic	0.010	Skin damage or problems with circulatory systems, and may have increased risk of getting cancer	Erosion of natural deposits; runoff from orchards; runoff from glass & electronics production wastes	0
IOC	Asbestos (fibers >10 micrometers)	7 million fibers per Liter (MFL)	Increased risk of developing benign intestinal polyps	Decay of asbestos cement in water mains; erosion of natural deposits	7 MFL
OC	Atrazine	0.003	Cardiovascular system or reproductive problems	Runoff from herbicide used on row crops	0.003
IOC	Barium	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits	2
OC	Benzene	0.005	Anemia; decrease in blood platelets; increased risk of cancer	Discharge from factories; leaching from gas storage tanks and landfills	zero
OC	Benzo(a)pyrene (PAHs)	0.0002	Reproductive difficulties; increased risk of cancer	Leaching from linings of water storage tanks and distribution lines	zero
IOC	Beryllium	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries	0.004
R	Beta photon emitters	4 millirems per year	Increased risk of cancer	Decay of natural and man-made deposits of certain minerals that are radioactive and may emit forms of radiation known as photons and beta radiation	zero
DBP	Bromate	0.010	Increased risk of cancer	Byproduct of drinking water disinfection	zero
IOC	Cadmium	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints	0.005
OC	Carbofuran	0.04	Problems with blood, nervous system, or reproductive system	Leaching of soil fumigant used on rice and alfalfa	0.04
OC	Carbon tetrachloride	0.005	Liver problems; increased risk of cancer	Discharge from chemical plants and other industrial activities	zero
D	Chloramines (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort; anemia	Water additive used to control microbes	MRDLG=4[1]
OC	Chlordane	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide	zero
D	Chlorine (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort	Water additive used to control microbes	MRDLG=4[1]
D	Chlorine dioxide (as ClO_2)	MRDL=0.8[1]	Anemia; infants, young children, and fetuses of pregnant women: nervous system effects	Water additive used to control microbes	MRDLG=0.8[1]
DBP	Chlorite	1.0	Anemia; infants, young children, and fetuses of pregnant women: nervous system effects	Byproduct of drinking water disinfection	0.8
OC	Chlorobenzene	0.1	Liver or kidney problems	Discharge from chemical and agricultural chemical factories	0.1
IOC	Chromium (total)	0.1	Allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits	0.1
IOC	Copper	TT[5]; Action Level = 1.3	Short-term exposure: Gastrointestinal distress. Long-term exposure: Liver or kidney damage. People with Wilson's Disease should consult their personal doctor if the amount of copper in their water exceeds the action level	Corrosion of household plumbing systems; erosion of natural deposits	1.3
M	*Cryptosporidium*	TT[7]	Short-term exposure: Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero

LEGEND

- D Disinfectant
- DBP Disinfection Byproduct
- IOC Inorganic Chemical
- M Microorganism
- OC Organic Chemical
- R Radionuclides

Contaminant		MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
IOC	Cyanide (as free cyanide)	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories	0.2
OC	2,4-D	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops	0.07
OC	Dalapon	0.2	Minor kidney changes	Runoff from herbicide used on rights of way	0.2
OC	1,2-Dibromo-3-chloropropane (DBCP)	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards	zero
OC	o-Dichlorobenzene	0.6	Liver, kidney, or circulatory system problems	Discharge from industrial chemical factories	0.6
OC	p-Dichlorobenzene	0.075	Anemia; liver, kidney or spleen damage; changes in blood	Discharge from industrial chemical factories	0.075
OC	1,2-Dichloroethane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC	1,1-Dichloroethylene	0.007	Liver problems	Discharge from industrial chemical factories	0.007
OC	cis-1,2-Dichloroethylene	0.07	Liver problems	Discharge from industrial chemical factories	0.07
OC	trans-1,2-Dichloroethylene	0.1	Liver problems	Discharge from industrial chemical factories	0.1
OC	Dichloromethane	0.005	Liver problems; increased risk of cancer	Discharge from drug and chemical factories	zero
OC	1,2-Dichloropropane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC	Di(2-ethylhexyl) adipate	0.4	Weight loss, liver problems, or possible reproductive difficulties	Discharge from chemical factories	0.4
OC	Di(2-ethylhexyl) phthalate	0.006	Reproductive difficulties; liver problems; increased risk of cancer	Discharge from rubber and chemical factories	zero
OC	Dinoseb	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables	0.007
OC	Dioxin (2,3,7,8-TCDD)	0.00000003	Reproductive difficulties; increased risk of cancer	Emissions from waste incineration and other combustion; discharge from chemical factories	zero
OC	Diquat	0.02	Cataracts	Runoff from herbicide use	0.02
OC	Endothall	0.1	Stomach and intestinal problems	Runoff from herbicide use	0.1
OC	Endrin	0.002	Liver problems	Residue of banned insecticide	0.002
OC	Epichlorohydrin	TT[4]	Increased cancer risk; stomach problems	Discharge from industrial chemical factories; an impurity of some water treatment chemicals	zero
OC	Ethylbenzene	0.7	Liver or kidney problems	Discharge from petroleum refineries	0.7
OC	Ethylene dibromide	0.00005	Problems with liver, stomach, reproductive system, or kidneys; increased risk of cancer	Discharge from petroleum refineries	zero
M	Fecal coliform and *E. coli*	MCL[6]	Fecal coliforms and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Microbes in these wastes may cause short term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a special health risk for infants, young children, and people with severely compromised immune systems.	Human and animal fecal waste	zero[6]
IOC	Fluoride	4.0	Bone disease (pain and tenderness of the bones); children may get mottled teeth	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories	4.0
M	*Giardia lamblia*	TT[7]	Short-term exposure: Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC	Glyphosate	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use	0.7
DBP	Haloacetic acids (HAA5)	0.060	Increased risk of cancer	Byproduct of drinking water disinfection	n/a[9]
OC	Heptachlor	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide	zero
OC	Heptachlor epoxide	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor	zero
M	Heterotrophic plate count (HPC)	TT[7]	HPC has no health effects; it is an analytic method used to measure the variety of bacteria that are common in water. The lower the concentration of bacteria in drinking water, the better maintained the water system is.	HPC measures a range of bacteria that are naturally present in the environment	n/a

LEGEND

D	Disinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

Contaminant		MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
OC	Hexachlorobenzene	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer	Discharge from metal refineries and agricultural chemical factories	zero
OC	Hexachlorocyclopentadiene	0.05	Kidney or stomach problems	Discharge from chemical factories	0.05
IOC	Lead	TT5; Action Level=0.015	Infants and children: Delays in physical or or mental development; children could show slight deficits in attention span and learning abilities; Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion of natural deposits	zero
M	*Legionella*	TT7	Legionnaire's Disease, a type of pneumonia	Found naturally in water; multiplies in heating systems	zero
OC	Lindane	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, gardens	0.0002
IOC	Mercury (inorganic)	0.002	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands	0.002
OC	Methoxychlor	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock	0.04
IOC	Nitrate (measured as Nitrogen)	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	10
IOC	Nitrite (measured as Nitrogen)	1	Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	1
OC	Oxamyl (Vydate)	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes	0.2
OC	Pentachlorophenol	0.001	Liver or kidney problems; increased cancer risk	Discharge from wood-preserving factories	zero
OC	Picloram	0.5	Liver problems	Herbicide runoff	0.5
OC	Polychlorinated biphenyls (PCBs)	0.0005	Skin changes; thymus gland problems; immune deficiencies; reproductive or nervous system difficulties; increased risk of cancer	Runoff from landfills; discharge of waste chemicals	zero
R	Radium 226 and Radium 228 (combined)	5 pCi/L	Increased risk of cancer	Erosion of natural deposits	zero
IOC	Selenium	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum and metal refineries; erosion of natural deposits; discharge from mines	0.05
OC	Simazine	0.004	Problems with blood	Herbicide runoff	0.004
OC	Styrene	0.1	Liver, kidney, or circulatory system problems	Discharge from rubber and plastic factories; leaching from landfills	0.1
OC	Tetrachloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from factories and dry cleaners	zero
IOC	Thallium	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories	0.0005
OC	Toluene	1	Nervous system, kidney, or liver problems	Discharge from petroleum factories	1
M	Total Coliforms	5.0 percent[8]	Coliforms are bacteria that indicate that other, potentially harmful bacteria may be present. See fecal coliforms and *E. coli*	Naturally present in the environment	zero
DBP	Total Trihalomethanes (TTHMs)	0.080	Liver, kidney or central nervous system problems; increased risk of cancer	Byproduct of drinking water disinfection	n/a[9]
OC	Toxaphene	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle	zero
OC	2,4,5-TP (Silvex)	0.05	Liver problems	Residue of banned herbicide	0.05
OC	1,2,4-Trichlorobenzene	0.07	Changes in adrenal glands	Discharge from textile finishing factories	0.07
OC	1,1,1-Trichloroethane	0.2	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories	0.2
OC	1,1,2-Trichloroethane	0.005	Liver, kidney, or immune system problems	Discharge from industrial chemical factories	0.003
OC	Trichloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from metal degreasing sites and other factories	zero

LEGEND

D Disinfectant	IOC Inorganic Chemical	OC Organic Chemical
DBP Disinfection Byproduct	M Microorganism	R Radionuclides

Contaminant		MCL or TT[1] (mg/L)[2]	Potential health effects from long-term[3] exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal (mg/L)[2]
M	Turbidity	TT[7]	Turbidity is a measure of the cloudiness of water. It is used to indicate water quality and filtration effectiveness (e.g., whether disease-causing organisms are present). Higher turbidity levels are often associated with higher levels of disease-causing microorganisms such as viruses, parasites and some bacteria. These organisms can cause short term symptoms such as nausea, cramps, diarrhea, and associated headaches.	Soil runoff	n/a
R	Uranium	30μg/L	Increased risk of cancer, kidney toxicity	Erosion of natural deposits	zero
OC	Vinyl chloride	0.002	Increased risk of cancer	Leaching from PVC pipes; discharge from plastic factories	zero
M	Viruses (enteric)	TT[7]	Short-term exposure: Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC	Xylenes (total)	10	Nervous system damage	Discharge from petroleum factories; discharge from chemical factories	10

LEGEND

D Disinfectant	IOC Inorganic Chemical	OC Organic Chemical
DBP Disinfection Byproduct	M Microorganism	R Radionuclides

NOTES

1 Definitions

- Maximum Contaminant Level Goal (MCLG)—The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.
- Maximum Contaminant Level (MCL)—The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.
- Maximum Residual Disinfectant Level Goal (MRDLG)—The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.
- Maximum Residual Disinfectant Level (MRDL)—The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
- Treatment Technique (TT)—A required process intended to reduce the level of a contaminant in drinking water.

2 Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million (ppm).

3 Health effects are from long-term exposure unless specified as short-term exposure.

4 Each water system must certify annually, in writing, to the state (using third-party or manufacturers certification) that when it uses acrylamide and/or epichlorohydrin to treat water, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows: Acrylamide = 0.05 percent dosed at 1 mg/L (or equivalent); Epichlorohydrin = 0.01 percent dosed at 20 mg/L (or equivalent).

5 Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10 percent of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.

6 A routine sample that is fecal coliform-positive or *E. coli*-positive triggers repeat samples--if any repeat sample is total coliform-positive, the system has an acute MCL violation. A routine sample that is total coliform-positive and fecal coliform-negative or *E. coli*-negative triggers repeat samples--if any repeat sample is fecal coliform-positive or *E. coli*-positive, the system has an acute MCL violation. See also Total Coliforms.

7 EPA's surface water treatment rules require systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:

- *Cryptosporidium*: 99 percent removal for systems that filter. Unfiltered systems are required to include Cryptosporidium in their existing watershed control provisions.
- Giardia lamblia: 99.9 percent removal/inactivation
- Viruses: 99.99 percent removal/inactivation
- *Legionella*: No limit, but EPA believes that if *Giardia* and viruses are removed/inactivated according to the treatment techniques in the surface water treatment rule, *Legionella* will also be controlled.
- Turbidity: For systems that use conventional or direct filtration, at no time can turbidity (cloudiness of water) go higher than 1 nephelolometric turbidity unit (NTU), and samples for turbidity must be less than or equal to 0.3 NTU in at least 95 percent of the samples in any month. Systems that use filtration other than conventional or direct filtration must follow state limits, which must include turbidity at no time exceeding 5 NTU.
- HPC: No more than 500 bacterial colonies per milliliter
- Long Term 1 Enhanced Surface Water Treatment; Surface water systems or ground water systems under the direct influence of surface water serving fewer than 10,000 people must comply with the applicable Long Term 1 Enhanced Surface Water Treatment Rule provisions (e.g. turbidity standards, individual filter monitoring, *Cryptosporidium* removal requirements, updated watershed control requirements for unfiltered systems).
- Long Term 2 Enhanced Surface Water Treatment; This rule applies to all surface water systems or ground water systems under the direct influence of surface water. The rule targets additional *Cryptosporidium* treatment requirements for higher risk systems and includes provisions to reduce risks from uncovered finished water storages facilities and to ensure that the systems maintain microbial protection as they take steps to reduce the formation of disinfection byproducts. (Monitoring start dates are staggered by system size. The largest systems (serving at least 100,000 people) will begin monitoring in October 2006 and the smallest systems (serving fewer than 10,000 people) will not begin monitoring until October 2008. After completing monitoring and determining their treatment bin, systems generally have three years to comply with any additional treatment requirements.)
- Filter Backwash Recycling: The Filter Backwash Recycling Rule requires systems that recycle to return specific recycle flows through all processes of the system's existing conventional or direct filtration system or at an alternate location approved by the state.

8 No more than 5.0 percent samples total coliform-positive in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive per month.) Every sample that has total coliform must be analyzed for either fecal coliforms or *E. coli*. If two consecutive TC-positive samples, and one is also positive for *E. coli* or fecal coliforms, system has an acute MCL violation.

9 Although there is no collective MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants:

- Haloacetic acids: dichloroacetic acid (zero); trichloroacetic acid (0.3 mg/L)
- Trihalomethanes: bromodichloromethane (zero); bromoform (zero); dibromochloromethane (0.06 mg/L)

Appendix B

Process and Instrumentation Diagrams

INSTRUMENT IDENTIFICATION LETTERS (NOTE 2)

	FIRST LETTER		SUCCEEDING LETTERS		
	MEASURED OR PROCESS VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	USER'S CHOICE			CONTROL	
D	DENSITY	DIFFERENTIAL			
E	VOLTAGE		SENSOR (PRIMARY ELEMENT)		
F	FLOW RATE	RATIO (FRACTION)			
G	USER'S CHOICE		GLASS, VIEWING DEVICE		
H	HAND				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER		SCAN		
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	MOTOR, MOISTURE	MOMENTARY			MIDDLE, INTERMEDIATE
N	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
O	USER'S CHOICE		ORIFICE,RESTRICTION		
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION		
Q	QUANTITY	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, OR LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE, PRESENCE	Y AXIS		RELAY, COMPUTE, CONVERT	
Z	POSITION, DIMENSION	Z AXIS		DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

GENERAL INSTRUMENT OR FUNCTION SYMBOLS (NOTE 2)

	FIELD MOUNTED	PRIMARY LOCATION, ACCESSIBLE TO OPERATOR	AUXILIARY LOCATION, ACCESSIBLE TO OPERATOR	NORMALLY INACCESSIBLE OR BEHIND THE PANEL
DISCRETE INSTRUMENTS				
PROGRAMMABLE LOGIC CONTROL				

A B C D E

A INSTRUMENT IDENTIFICATION LETTERS (SEE TABLE ABOVE)
B LOOP NUMBER
C MODIFIER
D SEQUENCE
E USER

EQUIPMENT LABELING CONVENTION

EQUIPMENT TYPE — ID#

X–XXX

EQUIPMENT			
BLOWER	B	PUMP	P
COMPRESSOR	C	MIXER	MIX
STOP GATE	G	SCREEN	SC
MOTOR	M	VALVE	V
SAMPLER	SMP	ODOR CONTROL UNIT	OCU

PIPE SIZE, SERVICE, AND MATERIAL IDENTIFICATION

(FOR REFERENCE ONLY. SEE SITE AND MECHANICAL DRAWINGS)

PIPE DIAMETER IN INCHES

18–PE–FRP

FLOW STREAM IDENTIFICATION

PIPE MATERIAL ABBREVIATION

LINE SYMBOLS

LINE	DESCRIPTION
	MAIN PROCESS FLOW (WITH TYPICAL DIRECTION OF FLOW SHOWN)
	MAIN (EXISTING)
	SUBSIDIARY PROCESS FLOW
	SUBSIDIARY (EXISTING)
	INSTRUMENT SUPPLY, PROCESS TAPS, NON PROCESS FLOW
	PNEUMATIC SIGNAL (ANALOG)
	ELECTRIC SIGNAL (ANALOG)
	PNEUMATIC SIGNAL (DISCRETE)
	ELECTRIC SIGNAL (DISCRETE)
	CAPILLARY TUBE OR FILLED SYSTEM
	ELECTROMAGNETIC OR SONIC SIGNAL (GUIDED)
	ELECTROMAGNETIC OR SONIC SIGNAL (UNGUIDED)
	SOFTWARE OR DATA LINK
	MECHANICAL LINK
	HYDRAULIC
120V	ELECTRIC POWER SUPPLY 120VAC, 60HZ U.N.O.
XX	SERVICE AIR OR INSTRUMENT AIR SUPPLY
	STRUCTURES AND SPECIAL EQUIPMENT
	AIR LINE
	EQUIPMENT BOUNDARY

MECHANICAL — ELECTRICAL

OR — CONNECTED

NOT CONNECTED

X | DWG #
DESCRIPTION — CONNECTION TO PROCESS WITHIN PROJECT

FLOW ELEMENTS

ORIFICE PLATE
SINGLE PORT PITOT TUBE OR PITOT–VENTURI TUBE
AVERAGING PITOT TUBE
FLUME
WEIR
TURBINE OR PROPELLER–TYPE PRIMARY ELEMENT
ROTAMETER
POSITIVE DISPLACEMENT TYPE FLOW TOTALIZING INDICATOR
VORTEX SENSOR
TARGET TYPE SENSOR
FLOW NOZZLE
M — MAGNETIC FLOWMETER
SONIC FLOWMETER
D — DENSITY METER
VENTURI

PROCESS ONLY — INSTRUMENTATION ONLY

VALVE / GATE SYMBOLS

GATE VALVE
3 WAY VALVE
BALL VALVE
3 WAY BALL VALVE
GLOBE VALVE
3 WAY GLOBE VALVE
PLUG VALVE
3 WAY PLUG VALVE
ECCENTRIC PLUG VALVE
NEEDLE VALVE
BUTTERFLY VALVE
VENTED BALL VALVE
SWING CHECK VALVE
WAFER CHECK VALVE
BALL CHECK VALVE
DIAPHRAGM VALVE
REGULATED SIDE
SELF ACTUATED REGULATING VALVE
PINCH VALVE
SELF ACTUATED REGULATING VALVE W/ EXTERNAL TAP
COMBINATION AIR/VAC RELEASE VALVE
PRESSURE SAFETY VALVE
MUD VALVE
AIR RELEASE VALVE
VACUUM RELEASE VALVE
SHADED = CLOSED VALVE
UNSHADED = OPEN VALVE

VALVE IDENTIFIERS

B C A

A = TAG
B = SIZE
C = NORMAL STATE

OPERATORS

HAND
M — MOTORIZED
CYLINDER OPERATOR
S — SOLENOID
DIAPHRAGM
H — HYDRAULIC

INSTRUMENT & MECHANICAL EQUIPMENT SYMBOLS & MISCELLANEOUS

CENTRIFUGAL PUMP
SUBMERSIBLE PUMP – RAIL MOUNTED
VERTICAL PUMP
METERING PUMP
PROGRESSIVE CAVITY PUMP
SUBMERSIBLE PUMP
ROTARY PUMP
BLOWER
CALIBRATION CHAMBER
SILENCER
M — MOTOR
BACKFLOW PREVENTER
INTAKE SCREEN/FILTER
EXPANSION JOINT, FLEXIBLE SPOOL
DOUBLE CHECK
MIXER
NO NC — SLUICE GATE
FLAP GATE
NO NC — SLIDE GATE
NO NC — STOP GATE
INJECTOR
F — FILTER OR SEPARATOR
T — DRIP TRAP
HOSE BIBB CONNECTION
DIAPHRAGM SEAL
RUPTURE DISK, PRESSURE
RUPTURE DISK, VACUUM
M — SUBMERSIBLE MIXER
SPRAYER
IN–LINE PRESSURE SENSOR
W — PUMP SEAL OR VALVE WATER SUPPLY, PLANT WATER
FLANGE
UNION
Y STRAINER
FLOW STRAIGHTENING VANE
HOSE CONNECTION
CAP OR PLUG
BLIND FLANGE
PURGE
DRAIN
THERMOWELL
AIR COMPRESSOR
PULSATION DAMPENER
REDUCER
STATIC MIXER
HEAT TRACE
INTERLOCK. NUMBER IS THE NOTE IDENTIFIER (NOTE 3)
SYSTEM CONNECTION OUTSIDE PROJECT
XXX XXXXX — ELECTRICAL EQUIPMENT (SEE ABBREVIATIONS)

ABBREVIATIONS

AAS – ALKALINITY ADJUSTMENT SOLUTION
AC – ACID
AL – ALUM
AS – AIR SUPPLY
BW – BELT WASH WATER
BWR – BELT WASH WATER RECYCLE
CD – CONDENSATE
CDR – CONDENSER RETURN
CDS – CONDENSER SUPPLY
COMB – COMBUSTIBLES
CP – CONTROL PANEL
CPA – CONTROL POWER AVAILABLE
D – GRAVITY DRAIN
DE – DISINFECTED EFFLUENT
DIS – DISTILLED WATER
DS – DIGESTED SLUDGE
ECR – EFFLUENT COOLING RETURN
ECS – EFFLUENT COOLING SUPPLY
ED – EQUIPMENT DRAIN
EE – ENGINE EXHAUST
EFF – EFFLUENT
ES – ELECTRICAL SUPPLY
E–STOP – EMERGENCY STOP
F – FIRE SPRINKLER
FC – FAIL CLOSED
FCV – FLOW CONTROL VALVE
FD – FLOOR DRAIN
FIL – FILTRATE
FL – FAIL LAST
FLT – FAULT
FO – FAIL OPEN
FOR – FUEL OIL RETURN
FOS – FUEL OIL SUPPLY
FV – FUEL OIL, GASOLINE OR OIL VENT
G – STOP GATE
GR – GRIT
GRC – GAS RECIRCULATION
H2S – HYDROGEN SULFIDE
HIM – HUMAN INTERFACE MODULE
HOA – HAND–OFF–AUTO
HOH – HIGH PRESSURE HYDRAULIC OIL
HOL – LOW PRESSURE HYDRAULIC OIL
HOR – HAND–OFF–REMOTE
HRR – HEAT RESERVOIR RETURN
HRS – HEAT RESERVOIR SUPPLY
HWL – HIGH WATER LINE
HWS – DOMESTIC HOT WATER SUPPLY
IA – INSTRUMENT AIR
ISB – INTRINSIC SAFETY BARRIER
ISR – INTRINSIC SAFETY RELAY
I/O – ON/OFF
JOR – JOG–OFF–REMOTE
LCP – LOCAL CONTROL PANEL
LOR – LOCAL–OFF–REMOTE
LSR – LOWER–STOP–RAISE
ML – MIXED LIQUOR
MLR – MIXED LIQUOR RECYCLE
MS – MOTOR STARTER
MUD – MUD VALVE
MV – MOTORIZED VALVE
NaOH – SODIUM HYDROXIDE
NC – NORMALLY CLOSED
NG – NATURAL GAS
NO – NORMALLY OPEN
OA – ODOROUS AIR
OC – OPEN/CLOSE
OF – OVERFLOW
OSC – OPEN–STOP–CLOSE
OSCA – OPEN/STOP/CLOSE/AUTO
OT – OVER TEMP
PA – PROCESS AIR
PD – PUMPED DRAINAGE
PLC – PROGRAMMABLE LOGIC CONTROLLER
POL – POLYMER SOLUTION
PRS – PROCESS SAMPLING
PSV – PRESSURE SAFETY VALVE
PV – PNEUMATIC VALVE
PVC – POLYVINYL CHLORIDE
RNG – RUNNING
RP – RAW POLYMER
RS – RAW SEWAGE
RW – REUSE WATER
SA – SERVICE AIR
SC – SCUM
SD – SANITARY DRAIN
SDS – SCREENED/DEGRITTED RAW SEWAGE
SE – SECONDARY EFFLUENT
SF – SEAL FAILURE
SG – SLUICE GATE
SLG – SLIDE GATE
SN – SUPERNATANT
STD – STORM DRAIN
SV – SOLENOID VALVE
TD – TANK DRAIN
THS – THICKENED SLUDGE
TO – THICKENER OVERFLOW
TURB – TURBIDITY
UNO – UNLESS NOTED OTHERWISE
V – VENT
VAC – VACUUM
VFC – VALVE FULLY CLOSED
VFD – VARIABLE FREQUENCY DRIVE
VFO – VALVE FULLY OPEN
WAS – WASTE ACTIVATED SLUDGE
WML – WASTE MIXED LIQUOR
WNP – NON–POTABLE WATER
WP – POTABLE WATER
WRP – WATER RECLAIMATION PLANT

REVISIONS	DATE	BY
AS CONSTRUCTED	05/2017	AM

DESIGNED A. MAAS / R. YATES
DRAWN D. PETERSON
CHECKED E. DEE–OLSEN / G. WHITE
APPROVED B. BUNKER

ONE INCH AT FULL SCALE. IF NOT, SCALE ACCORDINGLY
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JOB No. 216–7367–002
DATE JANUARY 2016

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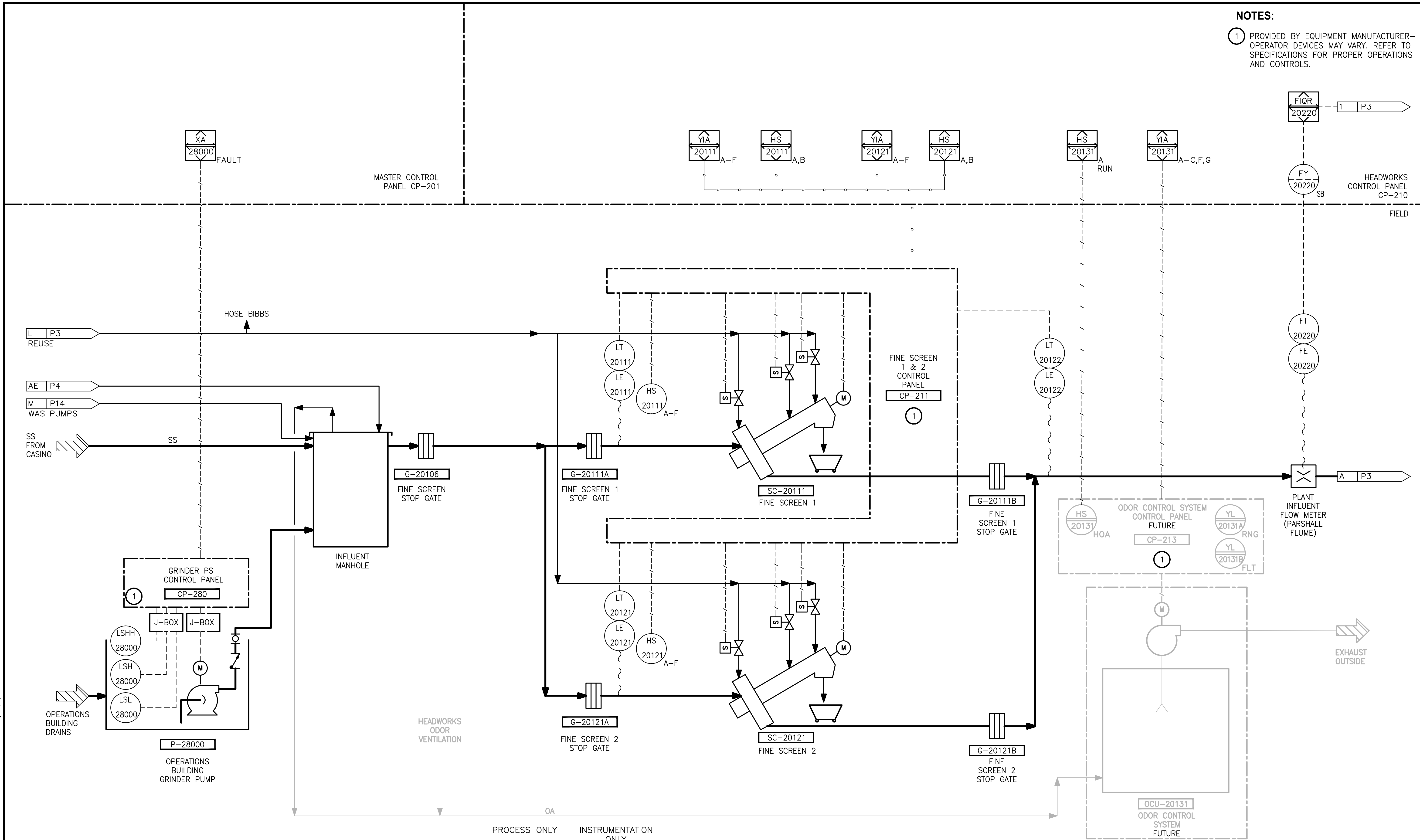
PROJECT NAME
WATER RECLAMATION PLANT
COWLITZ RESERVATION DEVELOPMENT

P&ID
LEGEND AND ABBREVIATIONS

DATE: May 02, 2017 – 1:25pm LAYOUT: P1
PLOTTED BY: milesdar
IMAGES: AM–sig | RAY–Sig |
XREFS: PMX 22X34 Puyallup | AM–PE | RAY–PE



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FILE NAME PS7367002P–2
JOB No. 216–7367–002
DATE JANUARY 2016

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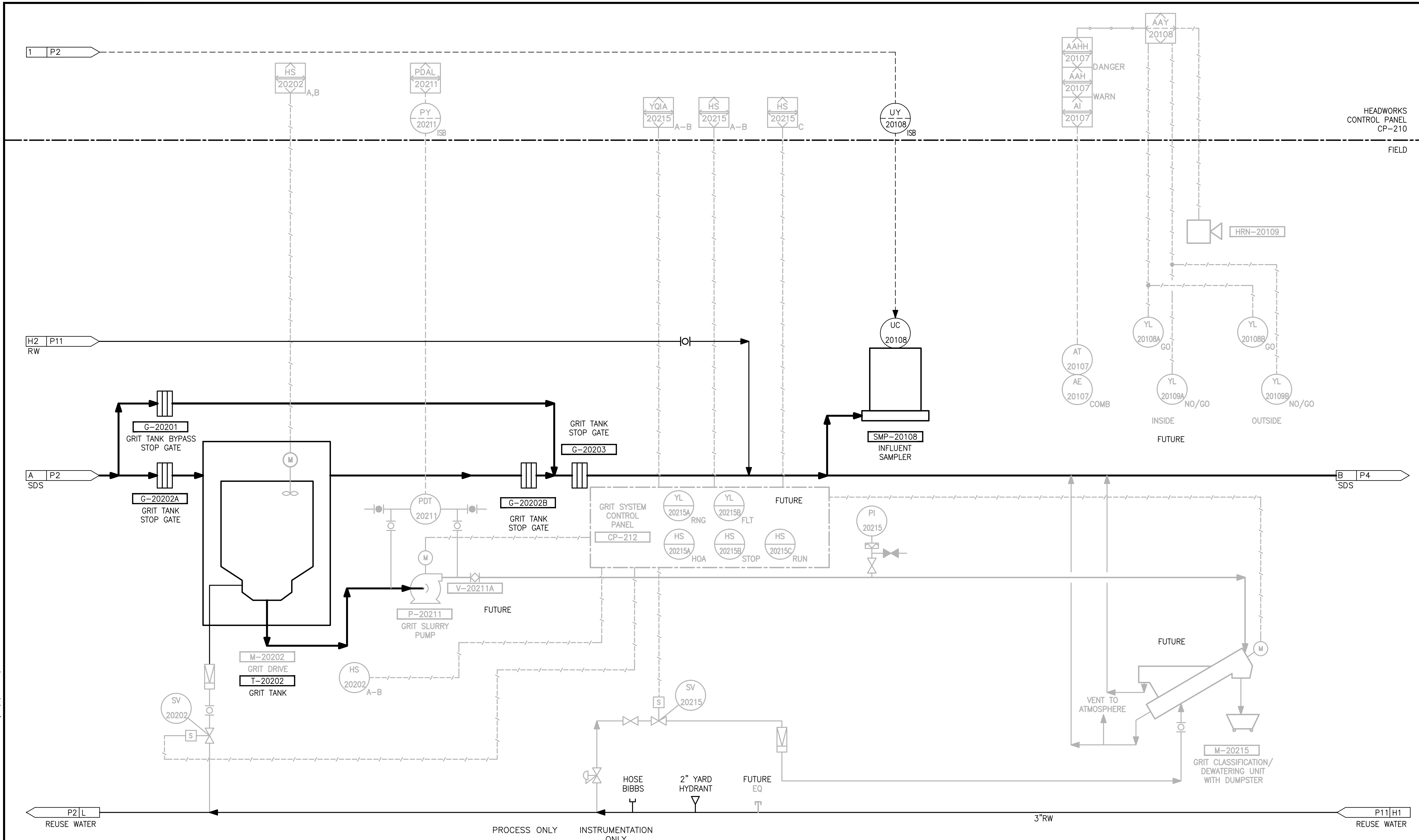
PROJECT NAME
WATER RECLAMATION PLANT
COWLITZ RESERVATION DEVELOPMENT

P&ID FINE SCREEN

DRAWING NO. 6 OF 176
P2

DATE: May 02, 2017 – 1:25pm LAYOUT: P2
PLOTTED BY: milesdar
IMAGES: AM–sig | RAY–Sig | XREFS: PMX 22X34 Puyallup | AM–PE | RAY–PE



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APPROVED B. BUNKER

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FILE NAME PS7367002P–3
JOB No. 216–7367–002
DATE JANUARY 2016

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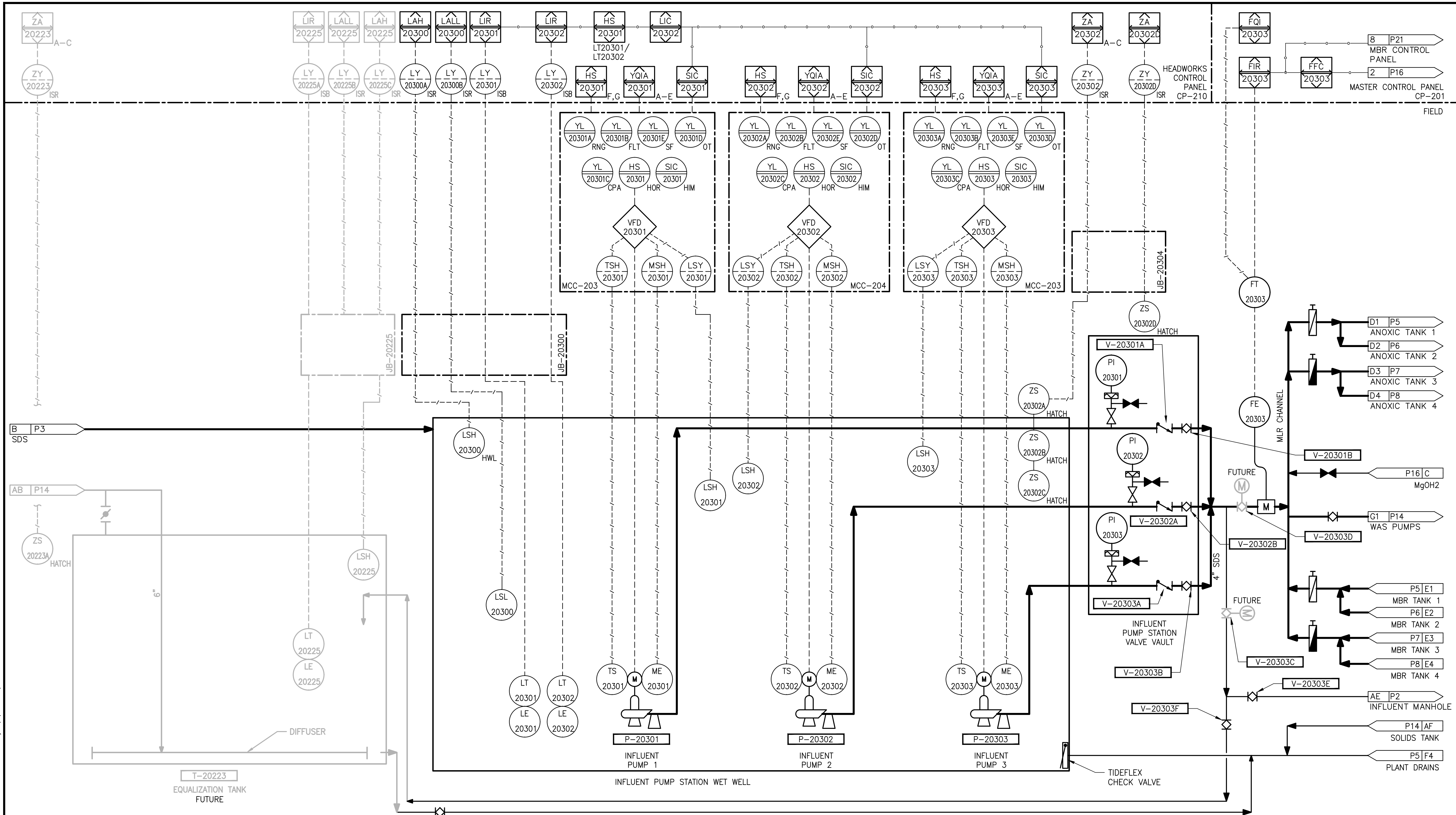
PROJECT NAME
WATER RECLAMATION PLANT
COWLITZ RESERVATION DEVELOPMENT

P&ID GRIT REMOVAL

DRAWING NO.
7 OF 176
P3

IMAGES: AM–sig | RAY–Sig |
XREF'S: PMX 22X34 Puyallup | AM–PE | RAY–PE
DATE: May 02, 2017 – 1:26pm LAYOUT: P3
PLOTTED BY: milesdar



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FILE NAME PS7367002P–4
JOB No. 216–7367–002
DATE JANUARY 2016

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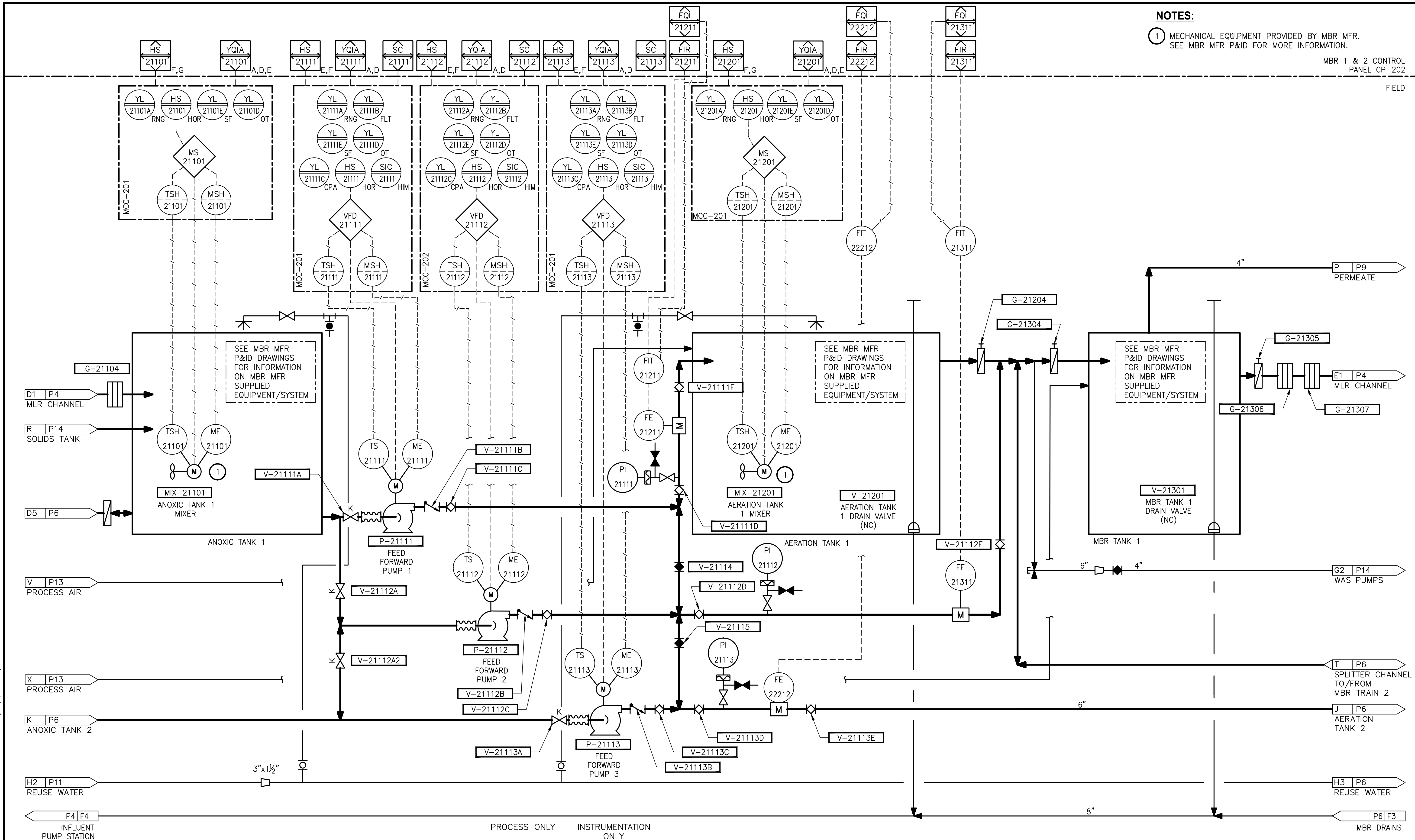
PROJECT NAME
WATER RECLAMATION PLANT
COWLITZ RESERVATION DEVELOPMENT

P&ID
INFLUENT PUMP STATION

DRAWING NO.

P4

DATE: May 02, 2017 – 1:27pm LAYOUT: P4
PLOTTED BY: milesdar
IMAGES: AM–sig | RAY–Sig | AM–PE | RAY–PE
XREFS: PMX 22X34 Puyallup



NOTES:

1. MECHANICAL EQUIPMENT PROVIDED BY MBR MFR. SEE MBR MFR P&ID FOR MORE INFORMATION.

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ONE INCH AT FULL SCALE. IF NOT, SCALE ACCORDINGLY
FILE NAME PS7367002P-5
JOB No. 216-7367-002
DATE JANUARY 2016

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PROJECT NAME
WATER RECLAMATION PLANT
COWLITZ RESERVATION DEVELOPMENT

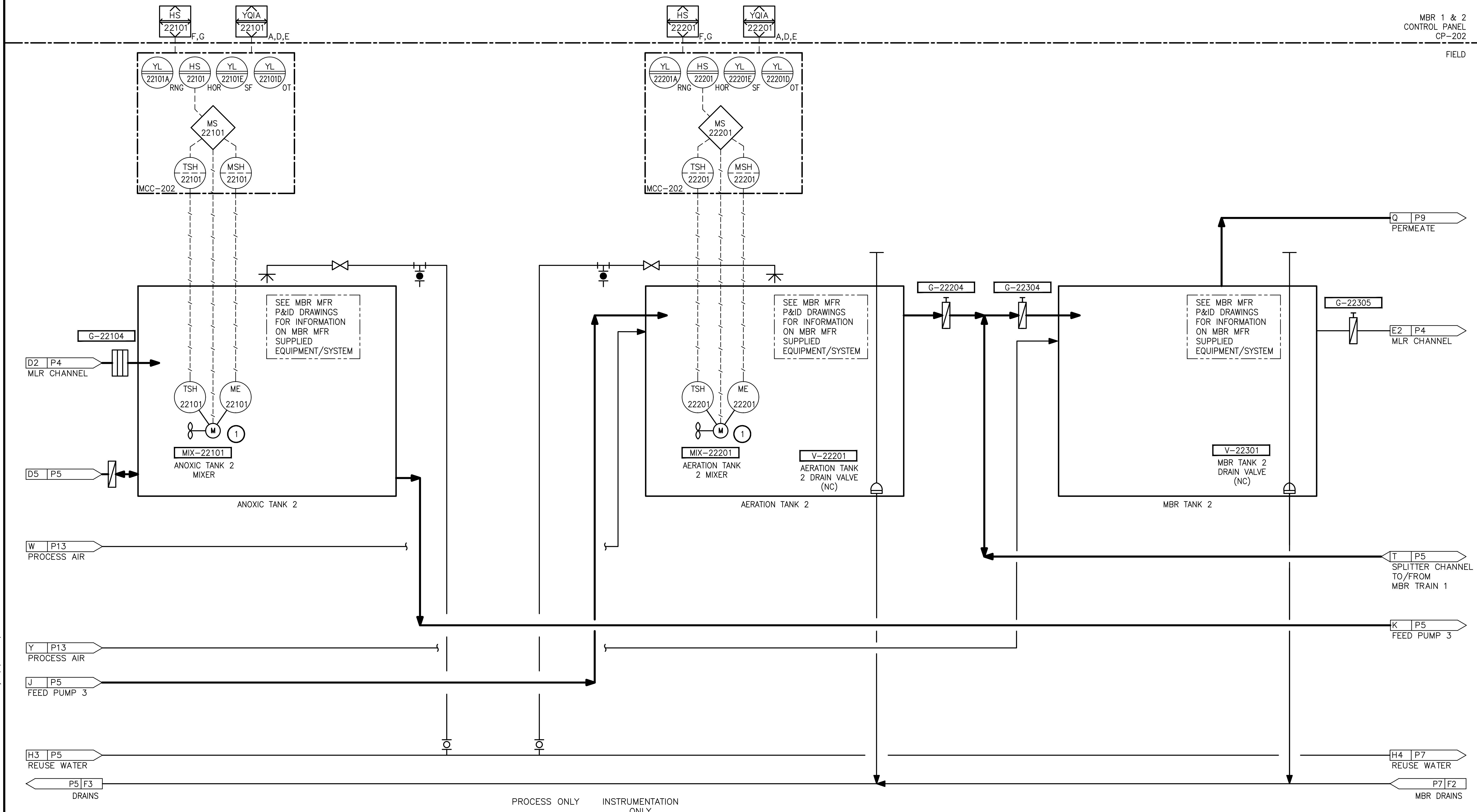
P&ID
MBR TRAIN 1

DRAWING NO.
9 OF 176
P5

IMAGES: AM-sig | RAY-Sig | AM-PE | RAY-PE
XREFS: PMX 22X34 Puyallup
DATE: May 02, 2017 - 1:28pm LAYOUT: P5

NOTES:

1. MECHANICAL EQUIPMENT PROVIDED BY MBR MFR. SEE MBR MFR P&ID FOR MORE INFORMATION.



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FILE NAME PS7367002P-6
JOB No. 216-7367-002
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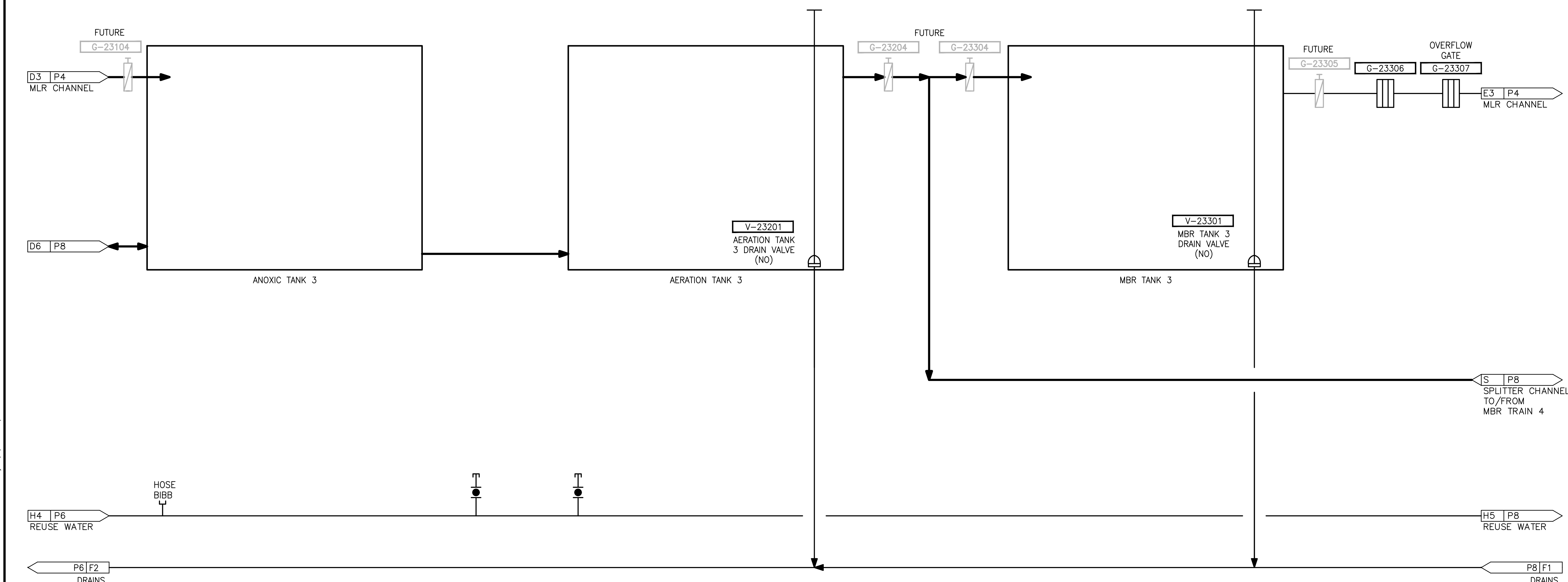
PROJECT NAME
WATER RECLAMATION PLANT
COWLITZ RESERVATION DEVELOPMENT

P&ID
MBR TRAIN 2

DRAWING NO.

P6

DATE: May 02, 2017 – 1:29pm LAYOUT: P6
PLOTTED BY: milesdar
IMAGES: AM-sig | RAY-Sig | XREFS: PMX 22X34 Puyallup | AM-PE | RAY-PE



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DRAWN K. BRAATEN
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ONE INCH AT FULL SCALE. IF NOT, SCALE ACCORDINGLY
FILE NAME PS7367002P-7
JOB No. 216-7367-002
DATE JANUARY 2016

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PROJECT NAME
WATER RECLAMATION PLANT
COWLITZ RESERVATION DEVELOPMENT

P&ID
MBR TRAIN 3

DRAWING NO.
11 OF 176
P7

DATE: May 02, 2017 - 1:30pm PLOTTED BY: milesdar LAYOUT: P7
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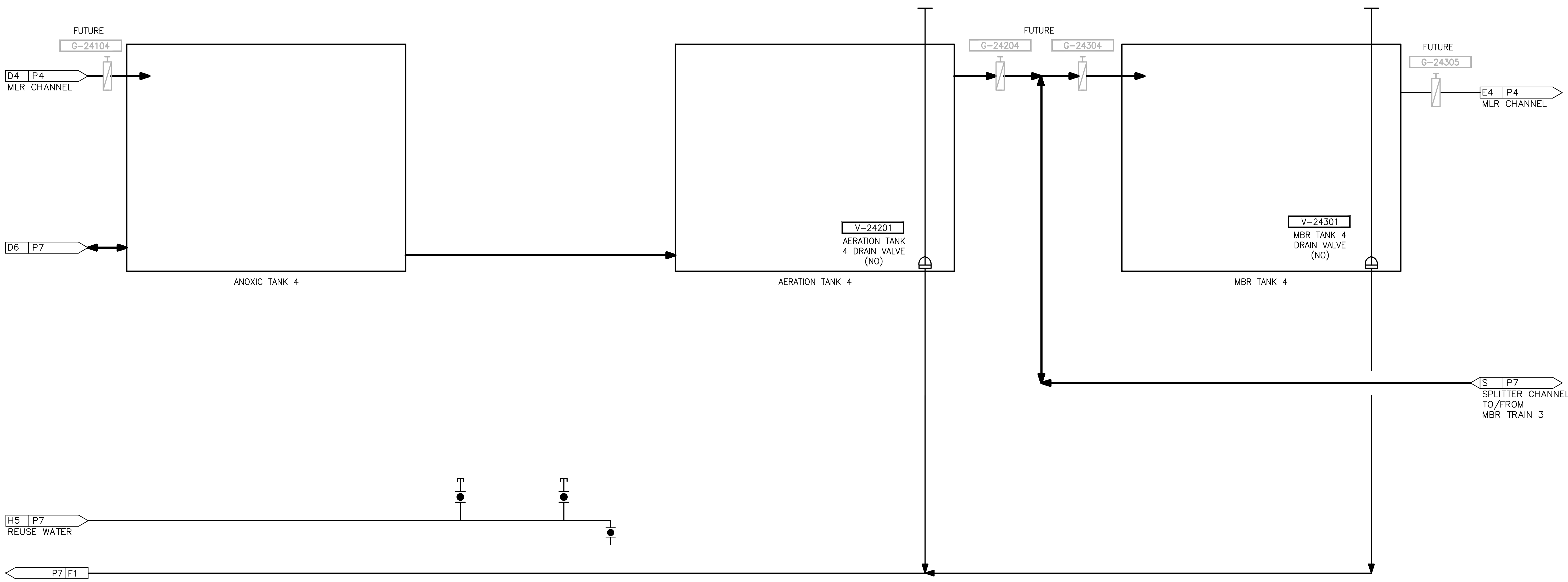

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FILE NAME PS7367002P-8
JOB No. 216-7367-002
DATE JANUARY 2016

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PROJECT NAME
WATER RECLAMATION PLANT
COWLITZ RESERVATION DEVELOPMENT

P&ID
MBR TRAIN 4

DRAWING NO.
12 OF 176
P8

DATE: May 02, 2017 - 1:31pm LAYOUT: P8
PLOTTED BY: milesdar
IMAGES: AM-sig | RAY-Sig |
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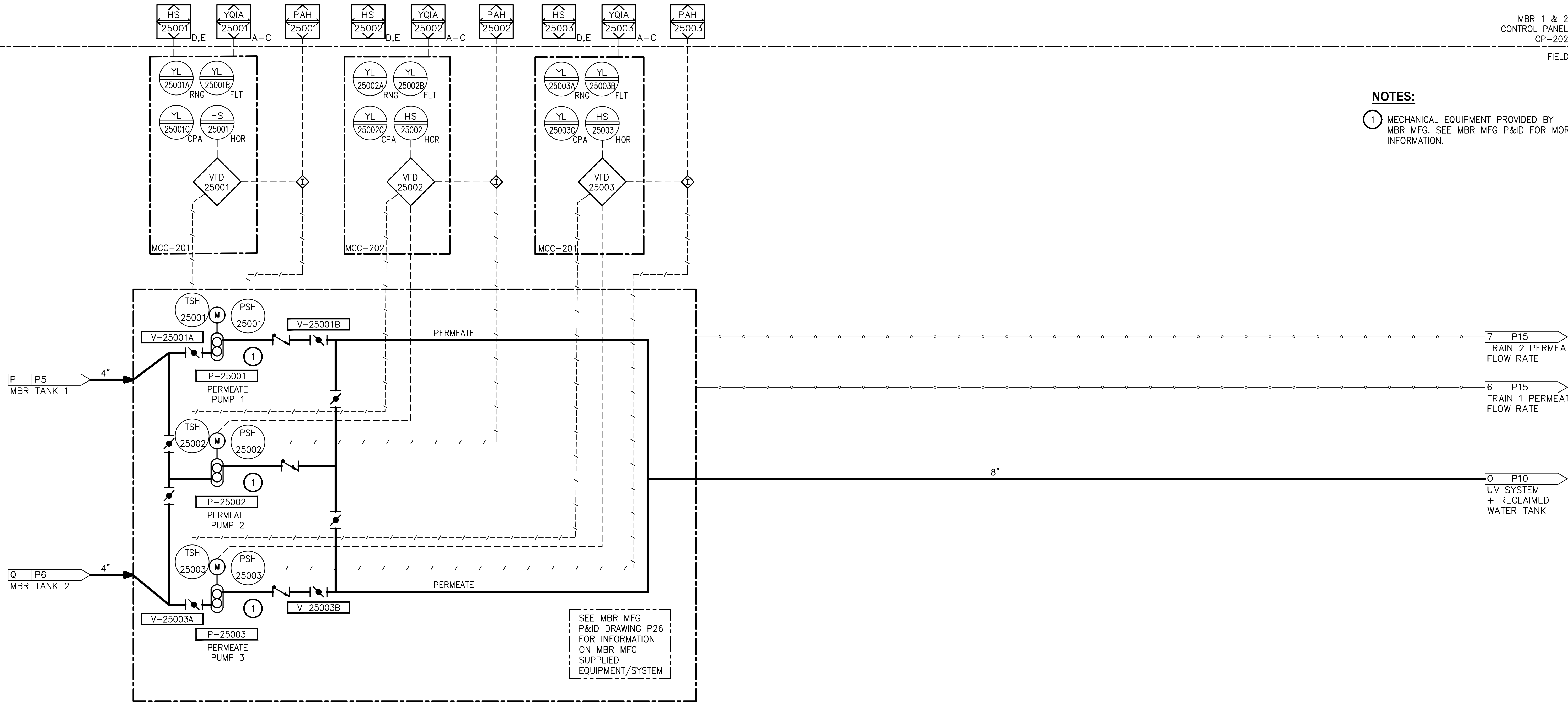

NOTES:

1. MECHANICAL EQUIPMENT PROVIDED BY MBR MFG. SEE MBR MFG P&ID FOR MORE INFORMATION.

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APPROVED B. BUNKER

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FILE NAME PS7367002P–9
JOB No. 216–7367–002
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PROJECT NAME
WATER RECLAMATION PLANT
COWLITZ RESERVATION DEVELOPMENT

P&ID
PERMEATE PUMPS

DRAWING NO.
13 OF 176
P9

DATE: May 02, 2017 – 1:31pm LAYOUT: P9
PLOTTED BY: milesdar
IMAGES: AM–sig | RAY–Sig | AM–PE | RAY–PE
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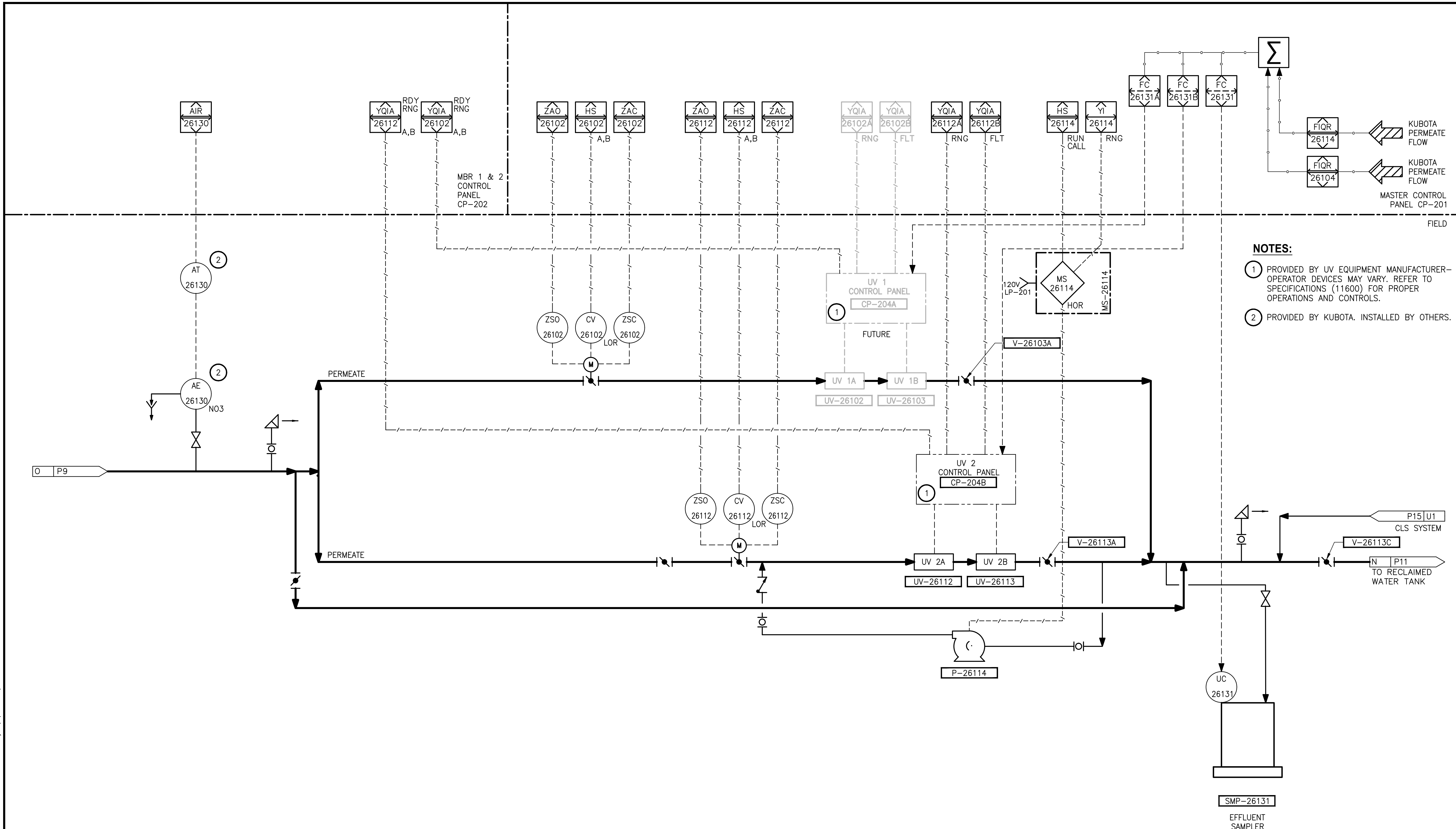

NOTES:

1. PROVIDED BY UV EQUIPMENT MANUFACTURER–OPERATOR DEVICES MAY VARY. REFER TO SPECIFICATIONS (11600) FOR PROPER OPERATIONS AND CONTROLS.
2. PROVIDED BY KUBOTA. INSTALLED BY OTHERS.

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	AS CONSTRUCTED	05/2017	AM

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FILE NAME PS7367002P-10
JOB No. 216-7367-002
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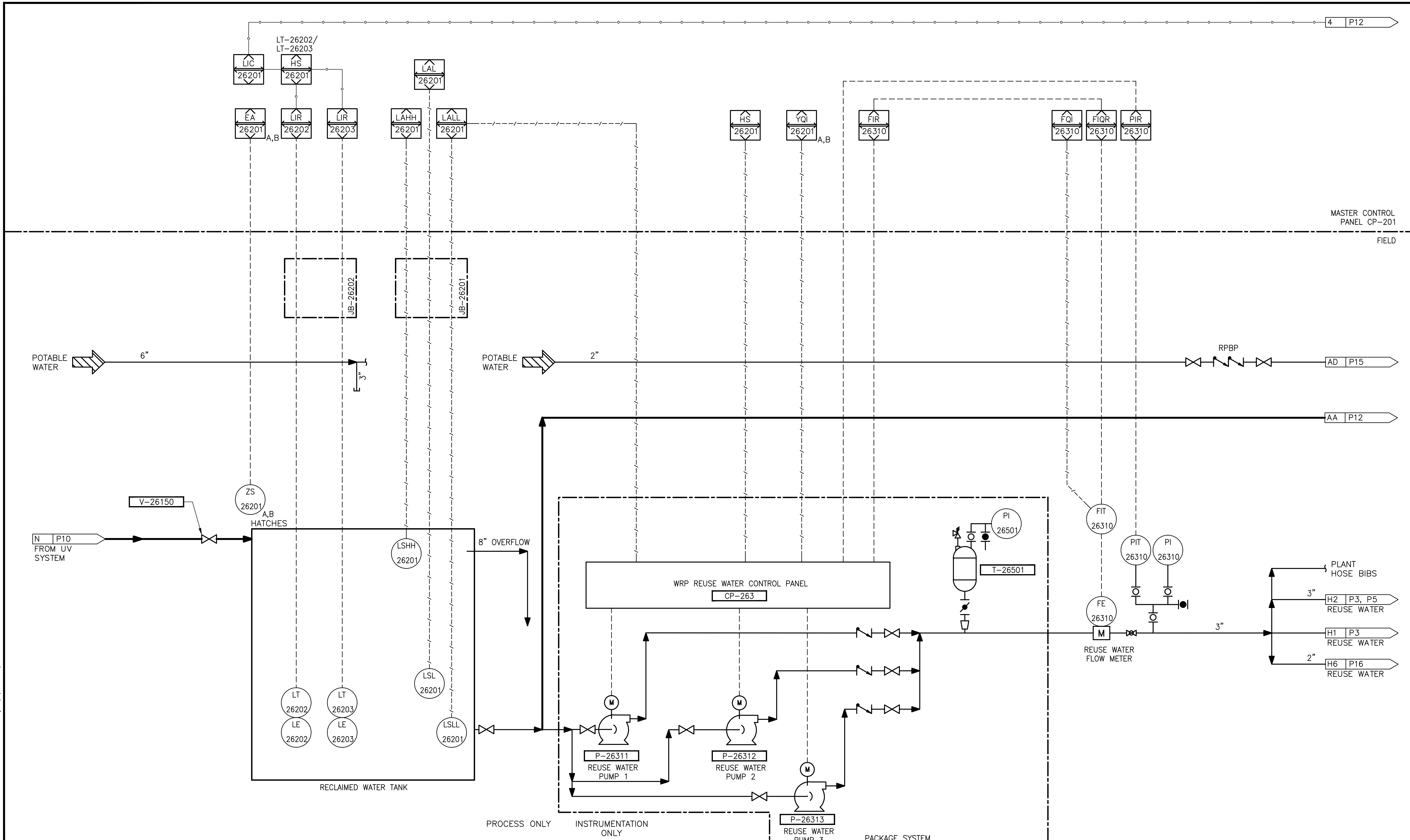
PROJECT NAME
WATER RECLAMATION PLANT
COWLITZ RESERVATION DEVELOPMENT

P&ID
UV SYSTEM

DRAWING NO.

P10

DATE: May 02, 2017 – 1:32pm LAYOUT: P10
PLOTTED BY: milesdar
IMAGES: AM-sig | RAY-Sig |
XREFS: PMX 22X34 Puyallup | AM-PE | RAY-PE



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	REVISIONS	DATE	BY
	AS CONSTRUCTED	05/2017	AM

DESIGNED A. MAAS / R. YATES
DRAWN D. PETERSON
CHECKED E. DEE-OLSEN / G. WHITE
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FILE NAME PS7367002P-11
JOB No. 216-7367-002
DATE JANUARY 2016

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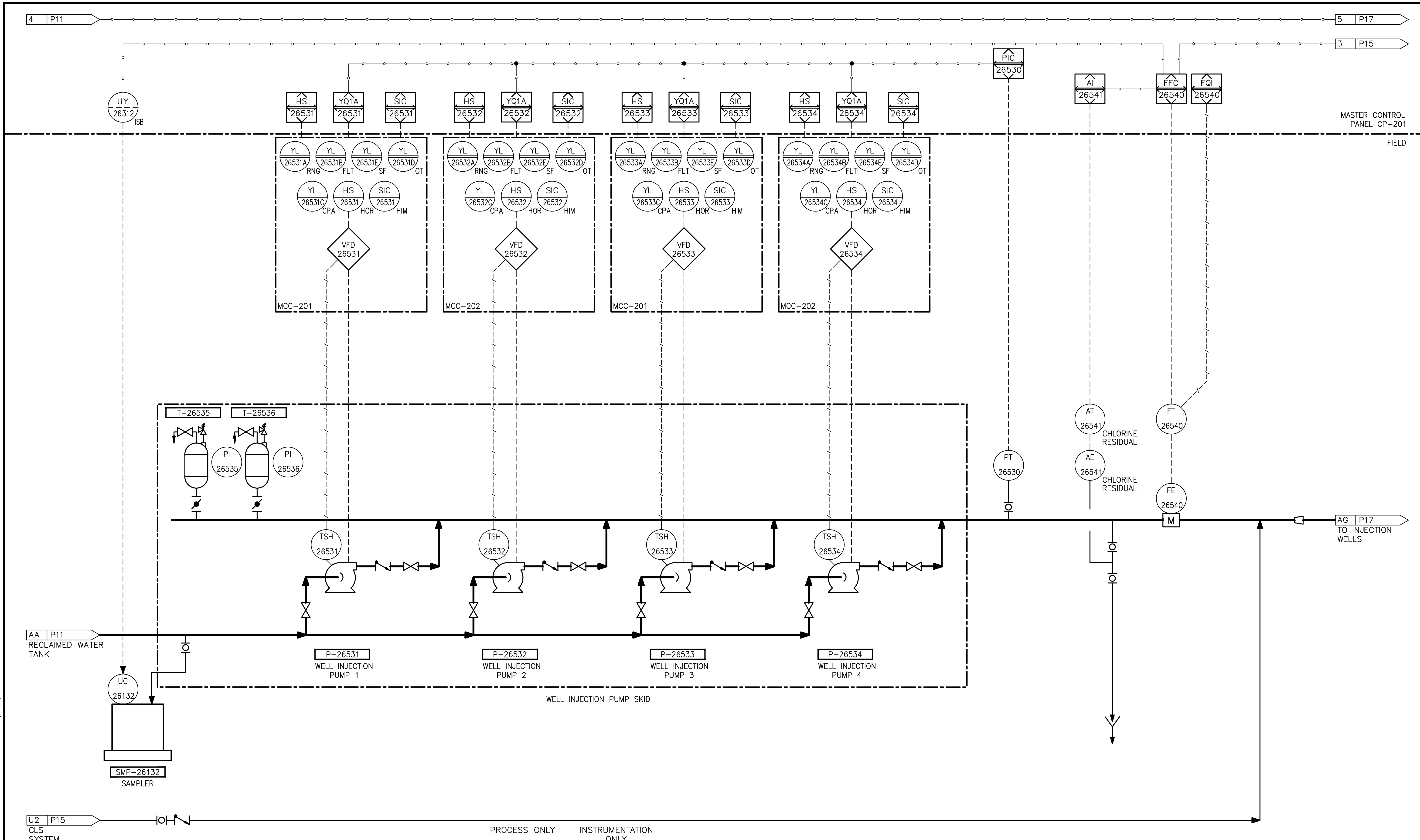
PROJECT NAME
WATER RECLAMATION PLANT
COWLITZ RESERVATION DEVELOPMENT

P&ID
RECLAIMED WATER TANK AND REUSE WATER PUMP SYSTEM

DRAWING NO.
15 OF 176
P11

DATE: May 02, 2017 - 1:34pm
PLOTTED BY: milesdar LAYOUT: P11
IMAGES: AM-sig | RAY-Sig |
XREF'S: PMX 22X34 Puyallup | AM-PE | RAY-PE



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XREFS: PMX 22X34 Puyallup
DATE: May 02, 2017 - 1:36pm LAYOUT: P12
PLOTTED BY: milesdar

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▷	REVISIONS	DATE	BY
	AS CONSTRUCTED	05/2017	AM

DESIGNED A. MAAS / H. WOODWARD
DRAWN D. PETERSON
CHECKED E. DEE-OLSEN / G. WHITE
APPROVED B. BUNKER

ONE INCH AT FULL SCALE. IF NOT, SCALE ACCORDINGLY
FILE NAME PS7367002P-12
JOB No. 216-7367-002
DATE JANUARY 2016

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PROJECT NAME
WATER RECLAMATION PLANT
COWLITZ RESERVATION DEVELOPMENT

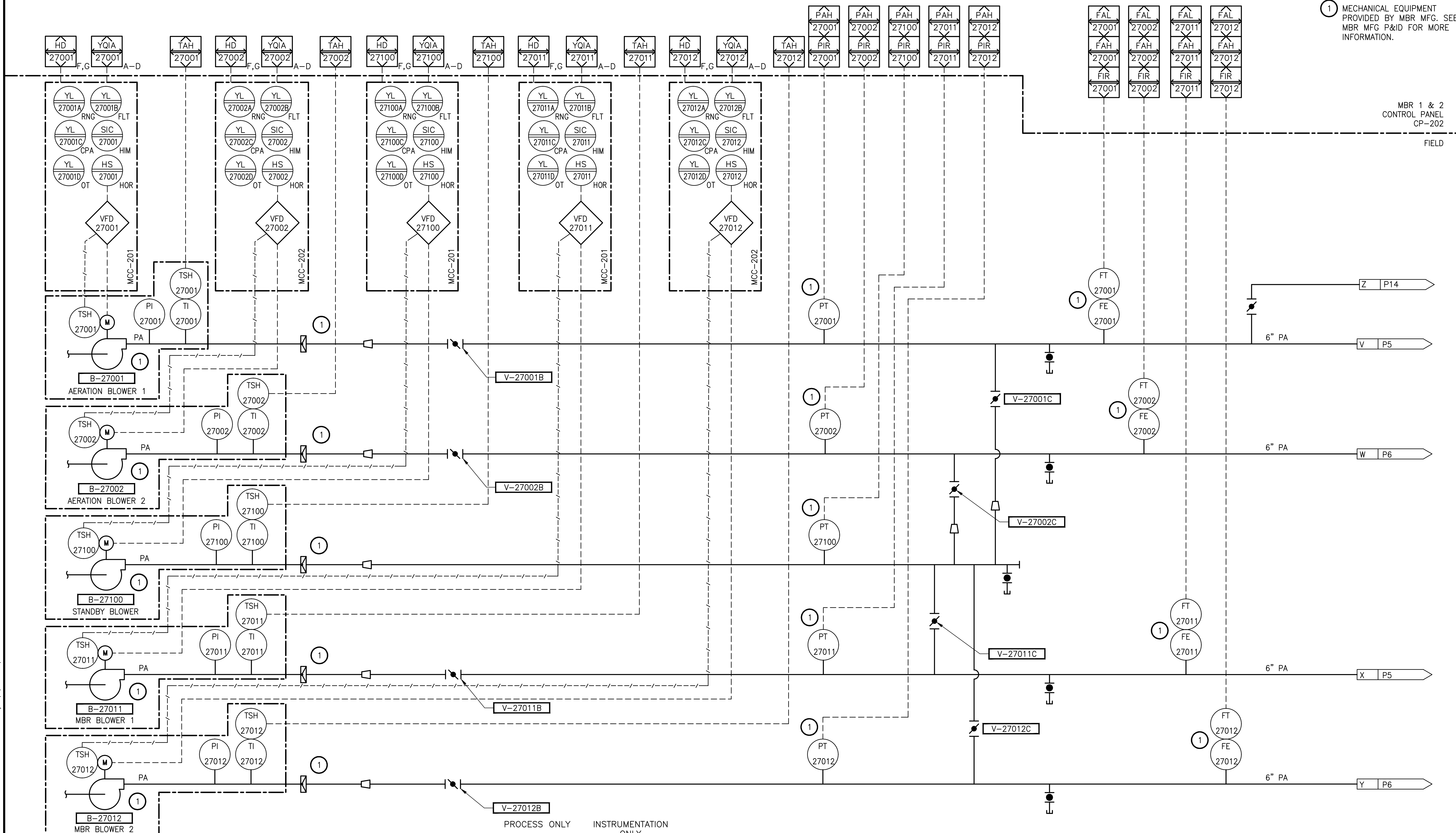
P&ID
WELL INJECTION PUMP SYSTEM

DRAWING NO.

P12

NOTES:

1. MECHANICAL EQUIPMENT PROVIDED BY MBR MFG. SEE MBR MFG P&ID FOR MORE INFORMATION.



REVISIONS	DATE	BY
AS CONSTRUCTED	05/2017	AM

DESIGNED A. MAAS / R. YATES
DRAWN D. PETERSON
CHECKED E. DEE–OLSEN / G. WHITE
APPROVED B. BUNKER

ONE INCH AT FULL SCALE. IF NOT, SCALE ACCORDINGLY
FILE NAME PS7367002P–13
JOB No. 216–7367–002
DATE JANUARY 2016

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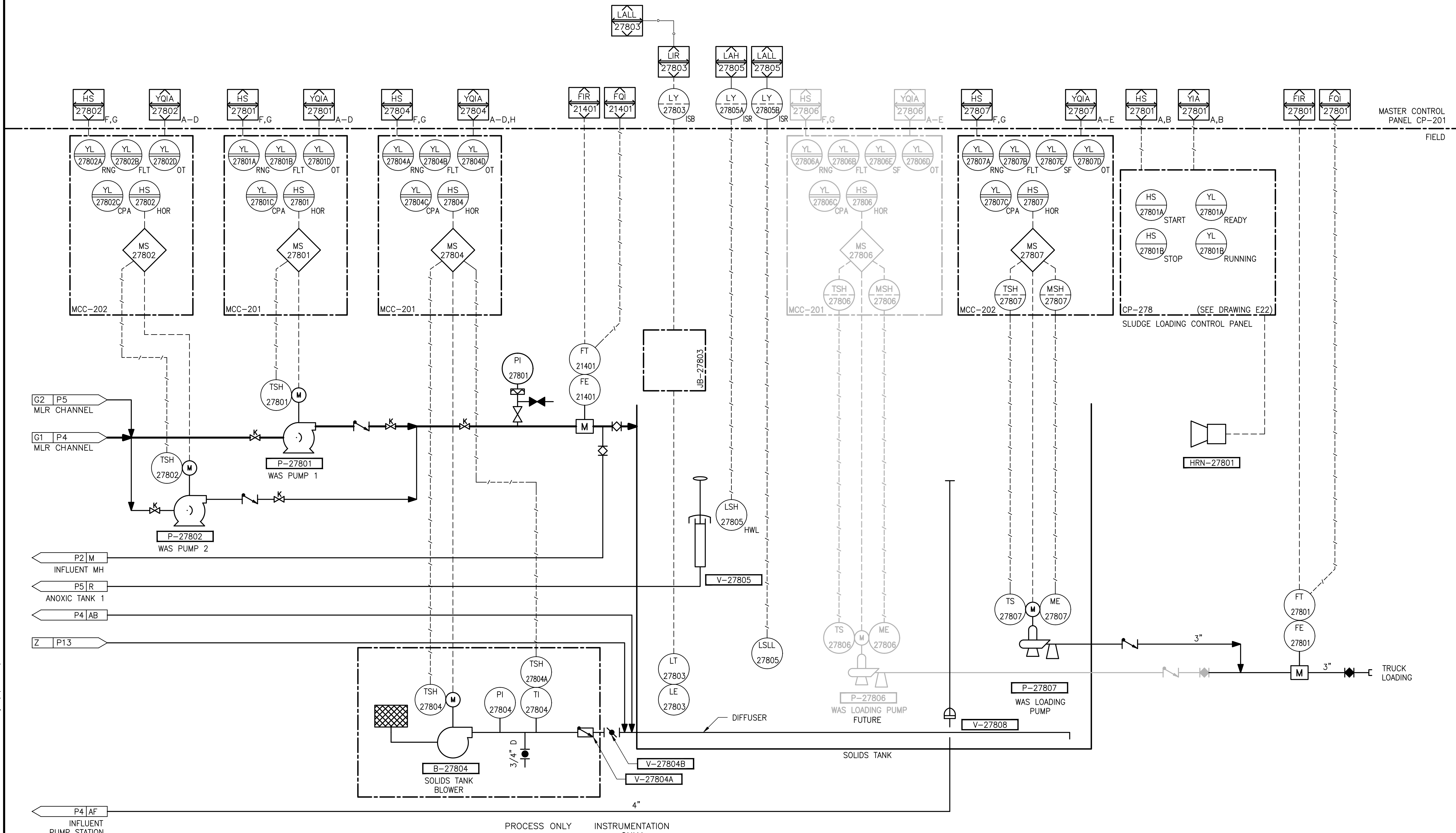
PROJECT NAME
WATER RECLAMATION PLANT
COWLITZ RESERVATION DEVELOPMENT

P&ID AERATION & MBR BLOWERS

DRAWING NO. 17 OF 176

P13

DATE: May 02, 2017 – 1:36pm LAYOUT: P13
PLOTTED BY: mdesdor
IMAGES: AM–sig | RAY–Sig | XREFS: PMX 22X34 Puyallup | AM–PE | RAY–PE



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	REVISIONS	DATE	BY
	AS CONSTRUCTED	05/2017	AM

DESIGNED A. MAAS / R. YATES
DRAWN D. PETERSON
CHECKED E. DEE-OLSEN / G. WHITE
APPROVED B. BUNKER

ONE INCH AT FULL SCALE. IF NOT, SCALE ACCORDINGLY
FILE NAME PS7367002P-14
JOB No. 216-7367-002
DATE JANUARY 2016

D:\AM-sig.png
D:\RAY-Sig.png

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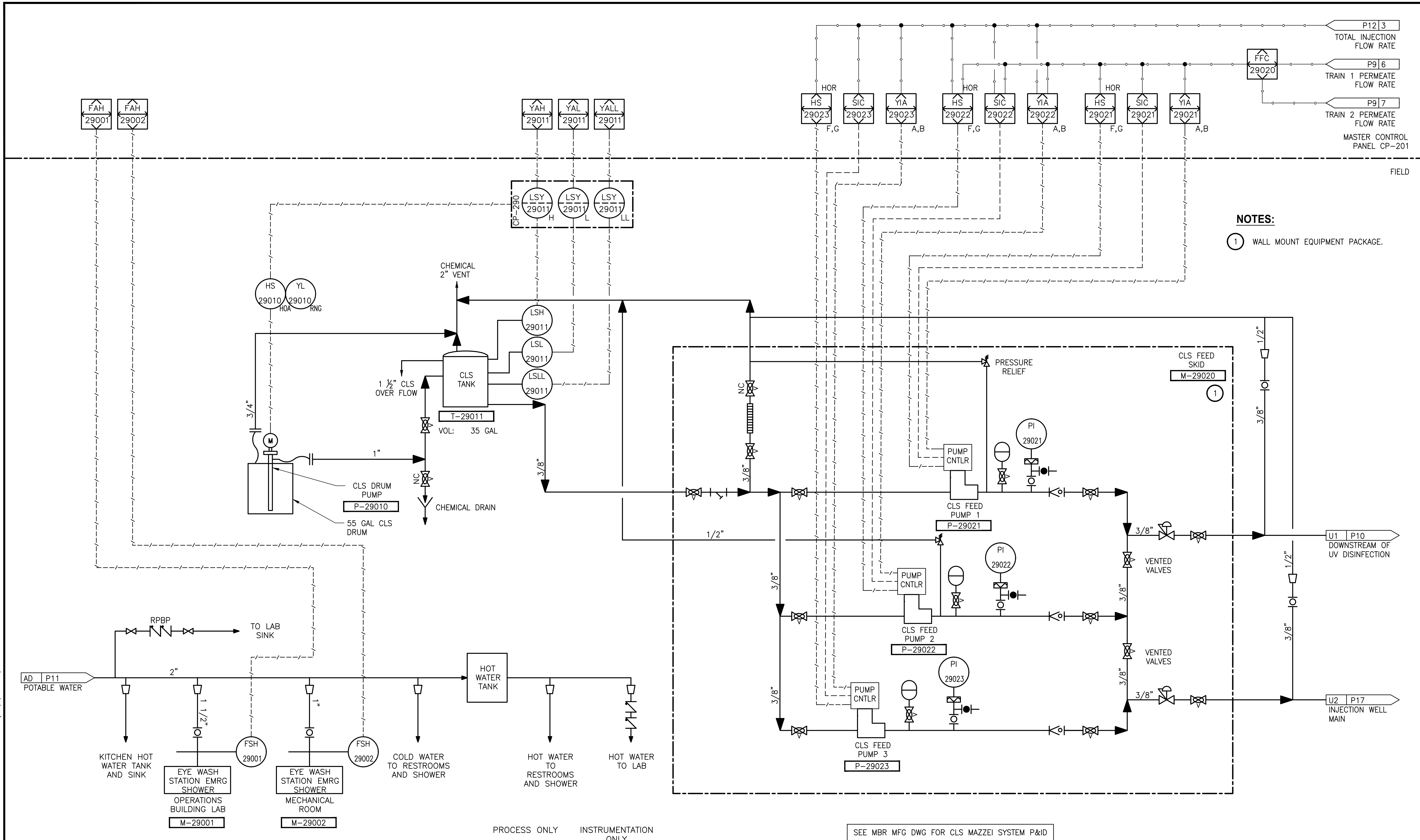
PROJECT NAME
WATER RECLAMATION PLANT
COWLITZ RESERVATION DEVELOPMENT

P&ID
SOLIDS TANK

DRAWING NO.

P14

DATE: May 02, 2017 – 1:42pm LAYOUT: P14
PLOTTED BY: milesdar
IMAGES: AM-sig | RAY-Sig | XREFS: PMX 22X34 Puyallup | AM-PE | RAY-PE



PROCESS ONLY

INSTRUMENTATION ONLY

SEE MBR MFG DWG FOR CLS MAZZEI SYSTEM P&ID

IMAGES: AM-sig | RAY-Sig | AM-PE | RAY-PE
XREFS: PMX 22X34 Puyallup

DATE: May 02, 2017 - 1:41pm LAYOUT: P15
PLOTTED BY: milesdar

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	REVISIONS	DATE	BY
	AS CONSTRUCTED	05/2017	AM

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DRAWN D. PETERSON
CHECKED E. DEE-OLSEN / G. WHITE
APPROVED B. BUNKER

ONE INCH AT FULL SCALE. IF NOT, SCALE ACCORDINGLY
FILE NAME PS7367002P-15
JOB No. 216-7367-002
DATE JANUARY 2016

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D:\RAY-Sig.png

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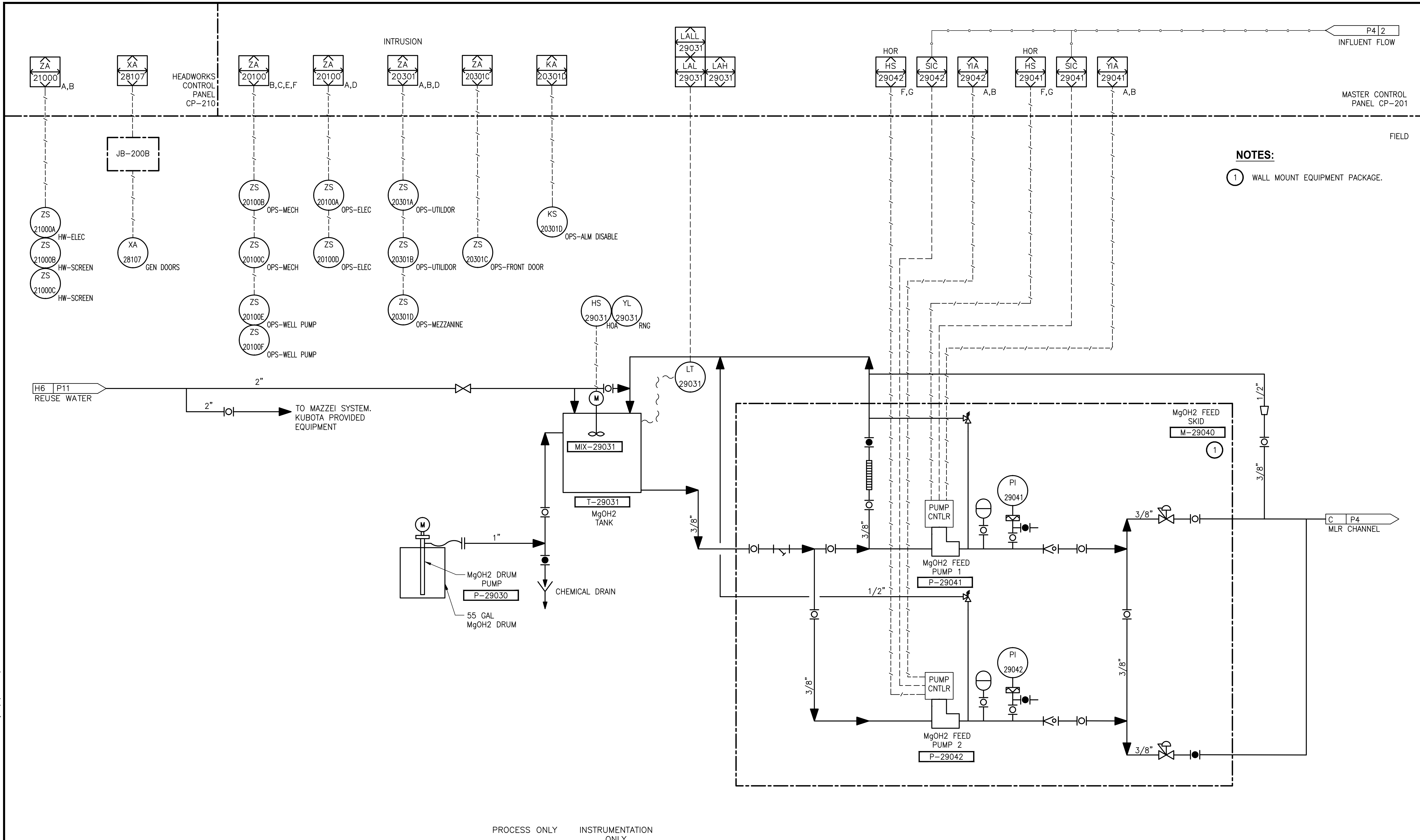
PROJECT NAME
WATER RECLAMATION PLANT
COWLITZ RESERVATION DEVELOPMENT

P&ID
SODIUM HYPOCHLORITE DISINFECTION SYSTEM

DRAWING NO.
19 OF 176
P15



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INSTRUMENTATION ONLY

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REVISIONS	DATE	BY
AS CONSTRUCTED	05/2017	AM

DESIGNED A. MAAS / R. YATES
DRAWN D. PETERSON
CHECKED E. DEE-OLSEN / G. WHITE
APPROVED B. BUNKER

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FILE NAME PS7367002P-16
JOB No. 216-7367-002
DATE JANUARY 2016

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D:\RAY-Sig.png

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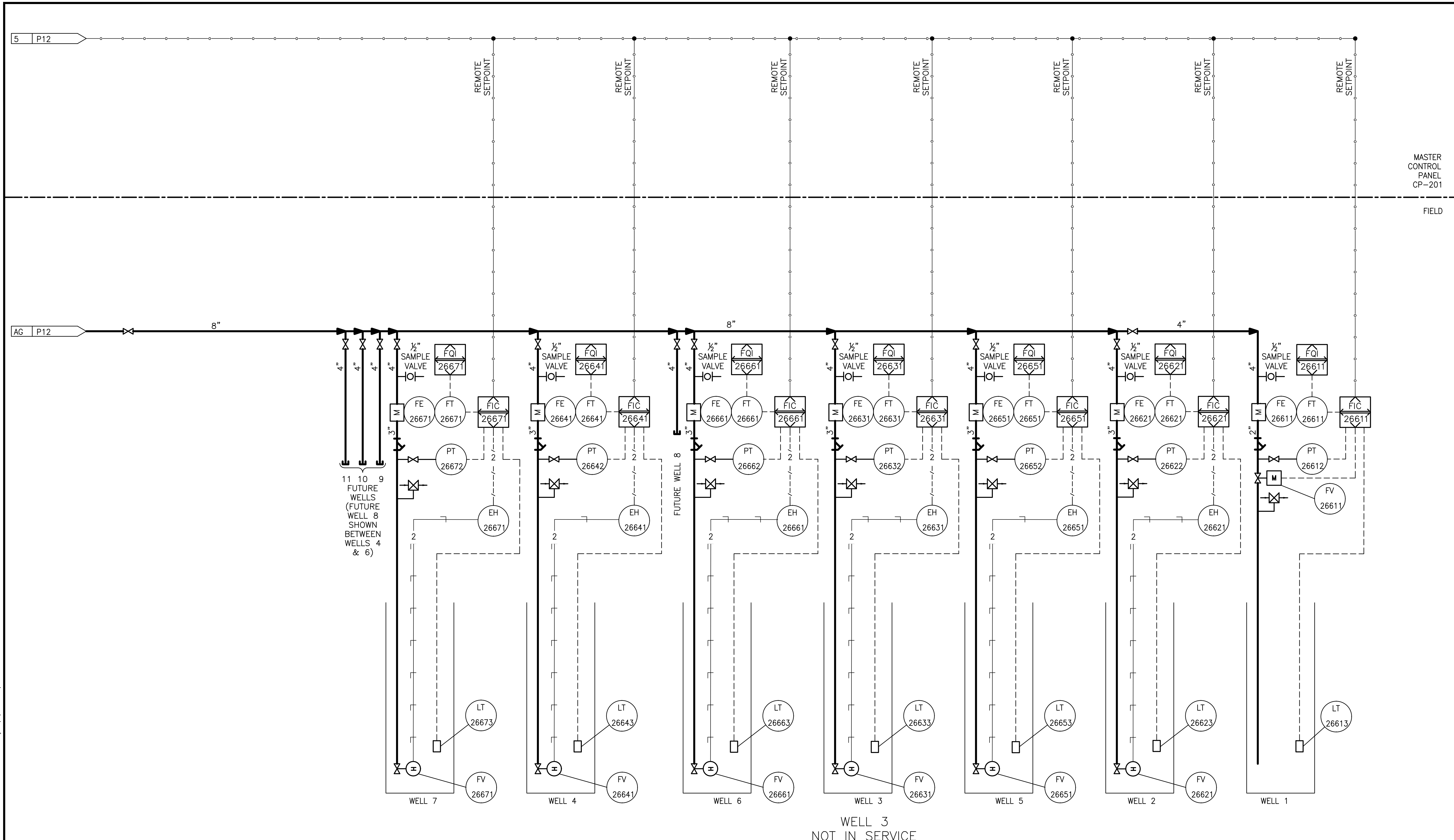
PROJECT NAME
WATER RECLAMATION PLANT
COWLITZ RESERVATION DEVELOPMENT

P&ID MAGNESIUM HYDROXIDE SYSTEM

DRAWING NO. 20 OF 176
P16

DATE: May 02, 2017 - 1:38pm LAYOUT: P16
PLOTTED BY: milesdar
IMAGES: AM-sig | RAY-Sig |
XREFS: PMX 22X34 Puyallup | AM-PE | RAY-PE



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	REVISIONS	DATE	BY
	AS CONSTRUCTED	05/2017	AM

DESIGNED A. MAAS / H. WOODWARD
DRAWN K. TAYLOR
CHECKED E. DEE–OLSEN / G. WHITE
APPROVED B. BUNKER

ONE INCH AT FULL SCALE. IF NOT, SCALE ACCORDINGLY
FILE NAME PS7367002P–17
JOB No. 216–7367–002
DATE JANUARY 2016

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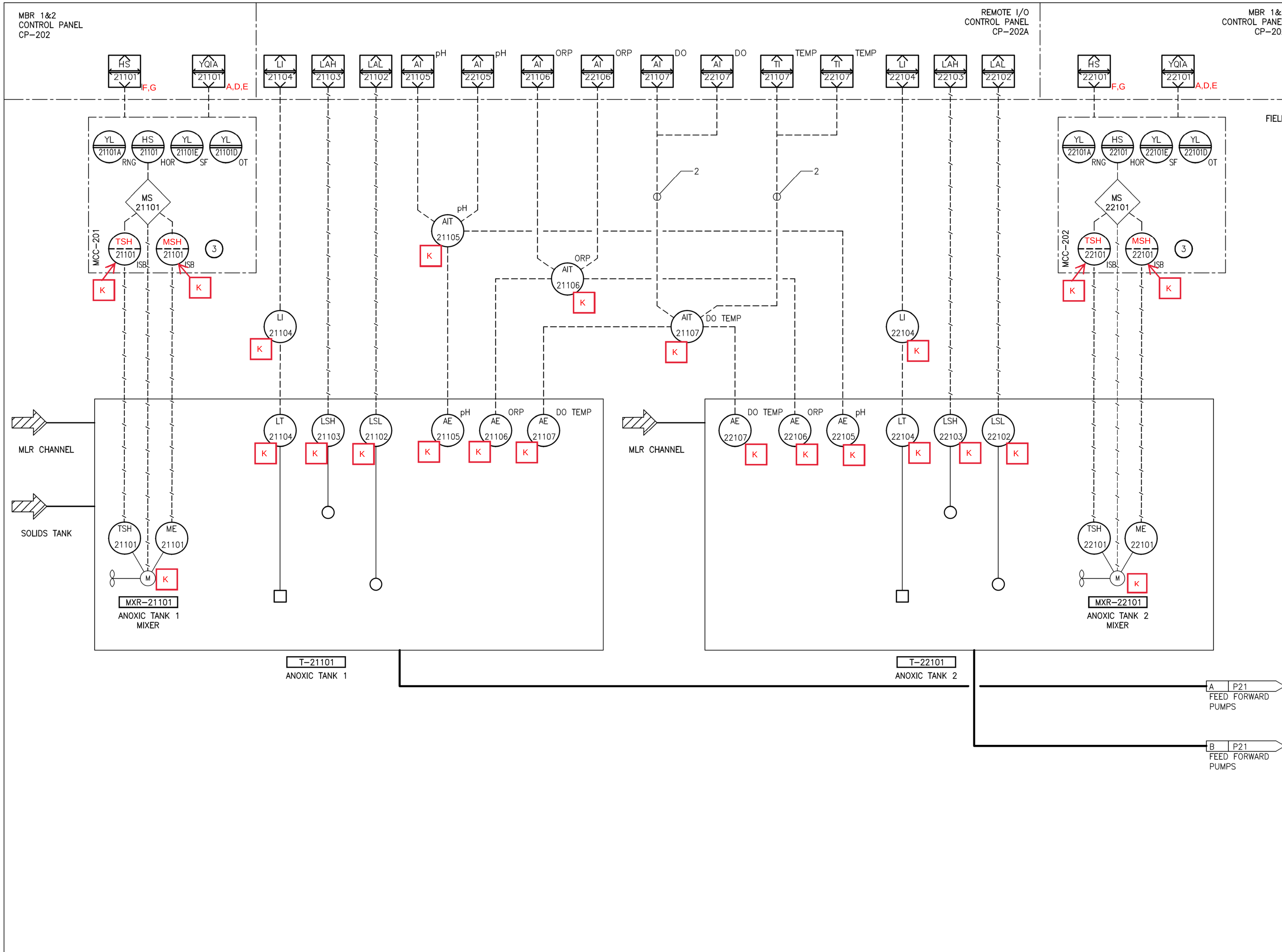
PROJECT NAME
WATER RECLAMATION PLANT
COWLITZ RESERVATION DEVELOPMENT

P&ID INJECTION WELLS

DRAWING NO.

P17

DATE: May 09, 2017 – 1:41pm PLOTTED BY: peterden LAYOUT: P17
IMAGES: AM–sig | HRW–sig | XREFS: PMX 22X34 Puyallup | AM–PE | HRW–PE



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For Earth, For Life

Kubota

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Tel; +1 425 898 2853

NOTES:

1 ALL ELECTRICAL WIRING, J-BOXES AND MCC's BY OTHERS

2 ALL ~~PIPING,~~ EQUIPMENT AND INSTRUMENTATION INSIDE TANKS SUPPLIED BY KUBOTA

3 TSY/MSY MOTOR PROTECTION MODULE SUPPLIED BY MIXER MANUFACTURER/KUBOTA AND INSTALLED IN MCC BY CONTRACTOR.

K Provided by Kubota and installed by contractor

No.	Revision/Issue	Date
1	SHINGO KUBO	10.7.16

Drawing Name
P&ID
ANOXIC TANKS
1 & 2

Project Name and Address
WATER RECLAMATION PLANT

COWLITZ RESERVATION DEVELOPMENT

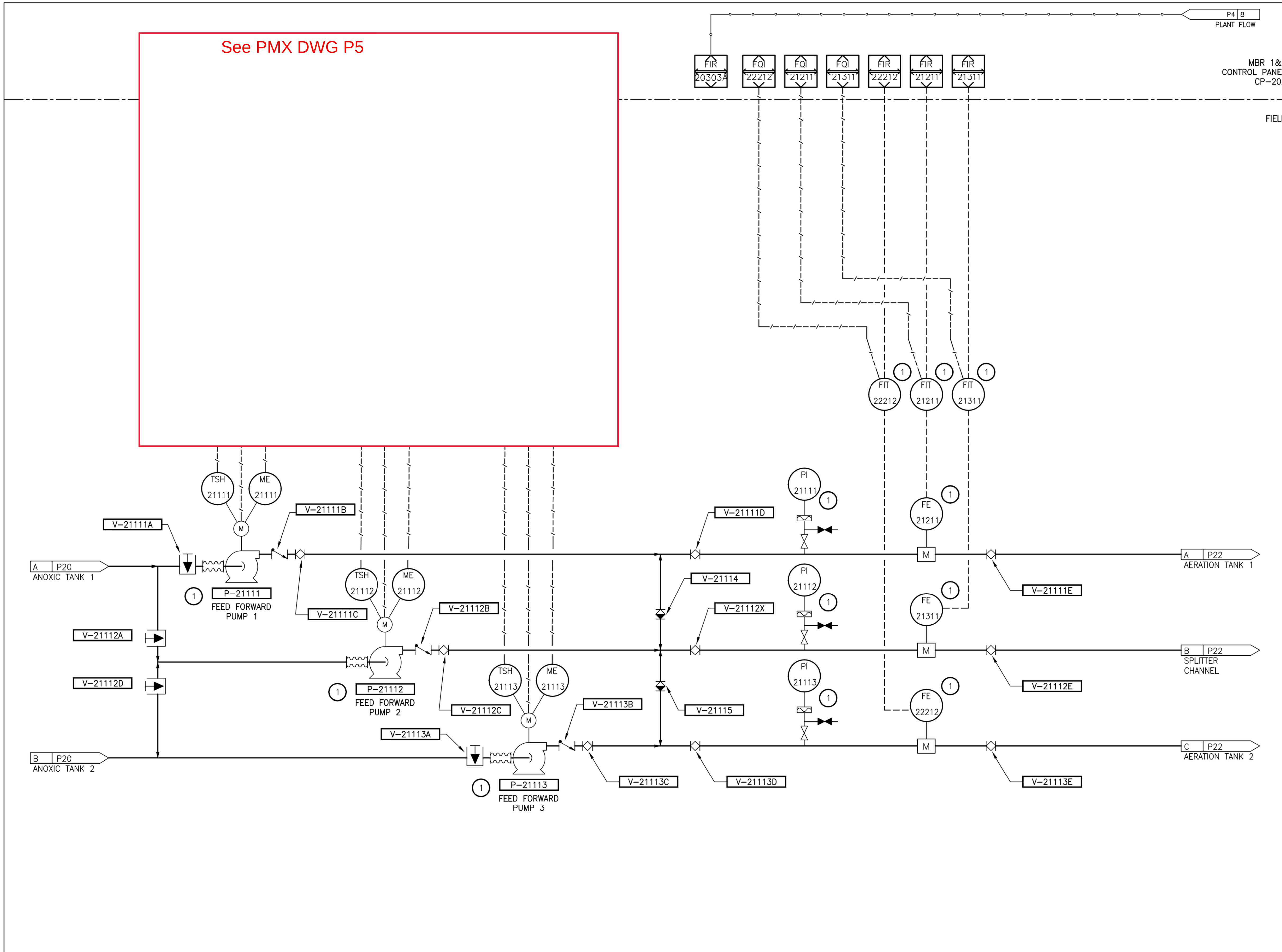
Area

Stamp

Drawing Number
P20

Author
B MAST

M-15- R2



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3. ALL PIPING AND VALVES SUPPLIED BY OTHERS
4. TSY/MSY MOTOR PROTECTION MODULE SUPPLIED BY PUMP MANUFACTURER AND INSTALLED IN J-BOX BY CONTRACTOR.

5 None of equipment or instruments is Kubota's scope

No.	Revision/Issue	Date
1	SHINGO KUBO	10.7.16

Drawing Name
P&ID
FEED FORWARD
PUMP STATION

Project Name and Address
WATER RECLAMATION PLANT

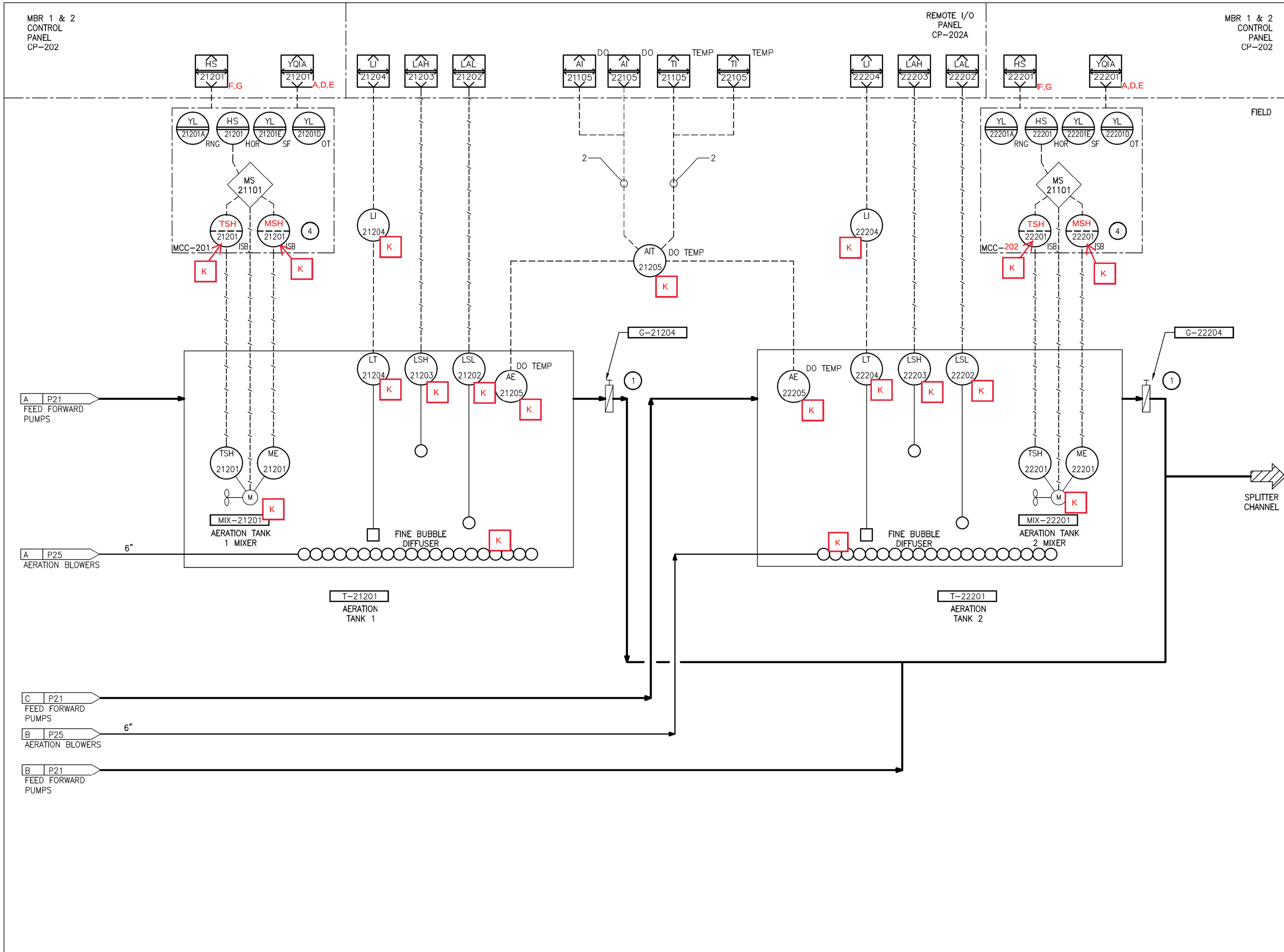
COWLITZ RESERVATION DEVELOPMENT

Area

Stamp

Drawing Number
P21

Author
B MAST



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3. ALL ~~PIPING,~~ EQUIPMENT AND INSTRUMENTATION INSIDE TANKS SUPPLIED BY KUBOTA
4. TSY/MSY MOTOR PROTECTION MODULE SUPPLIED BY MIXER MANUFACTURER/KUBOTA AND INSTALLED IN MCC BY CONTRACTOR.

K Provided by Kubota and installed by contractor

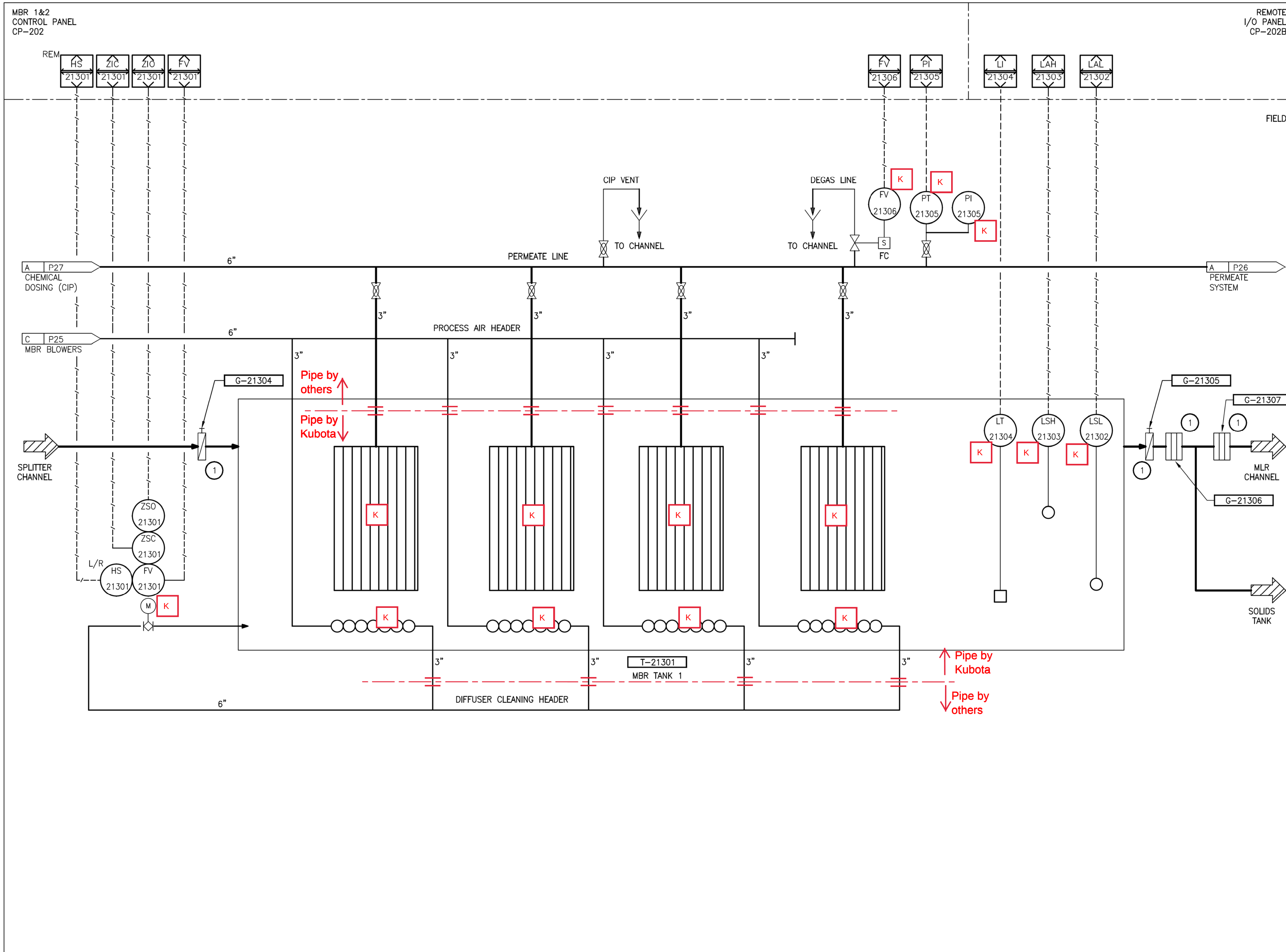
No.	Revision/Issue	Date
1	SHINGO KUBO	10.7.16

Drawing Name
P&ID
AERATION TANKS
1 & 2

Project Name and Address
WATER RECLAMATION PLANT

COWLITZ RESERVATION DEVELOPMENT

Area
Stamp
Drawing Number
P22
Author
B MAST



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K Provided by Kubota and installed by contractor

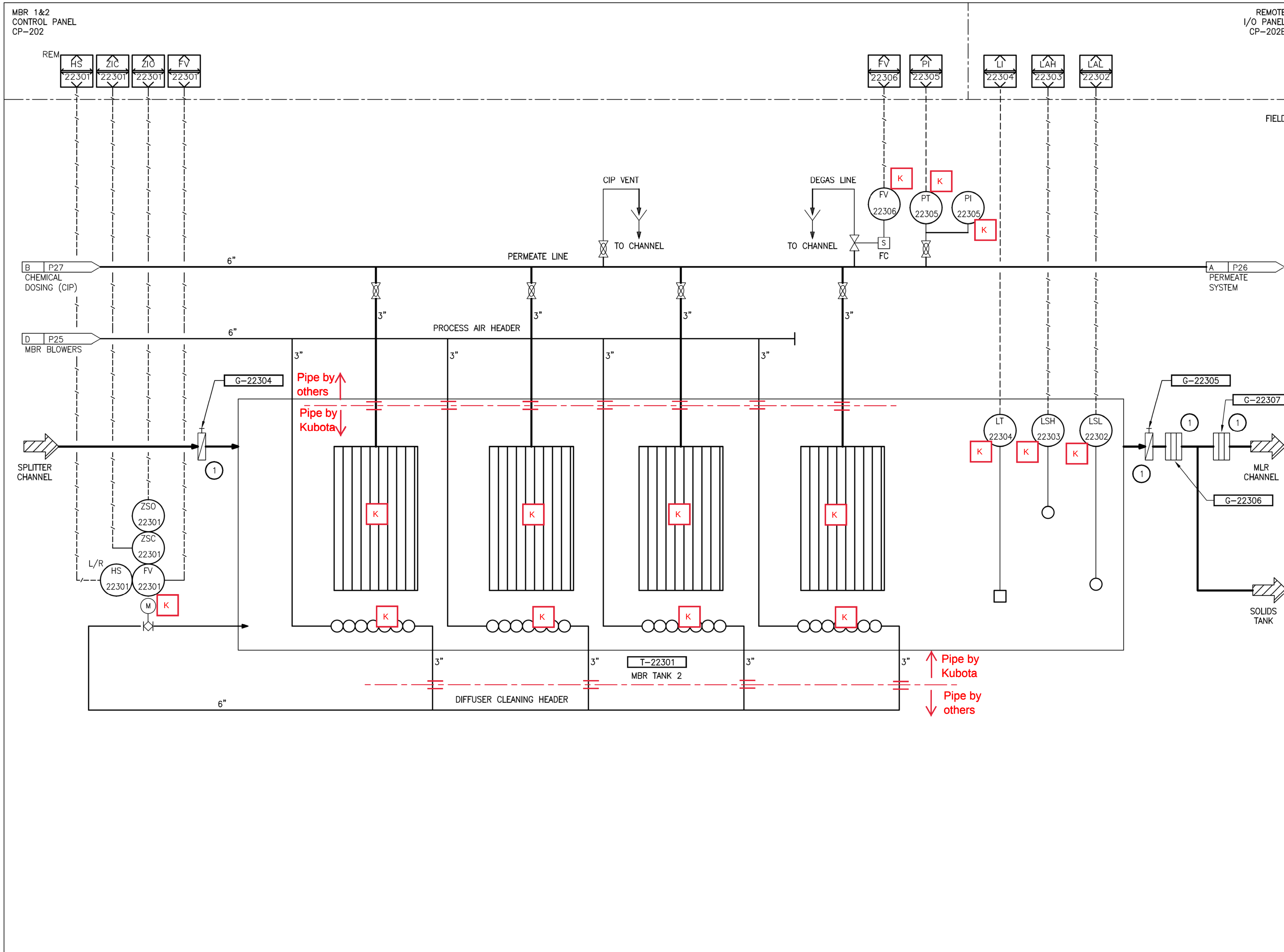
No.	Revision/Issue	Date
1	SHINGO KUBO	10.7.16

Drawing Name
P&ID
MEMBRANE
BIOREACTOR
TANK 1

Project Name and Address
WATER RECLAMATION
PLANT

COWLITZ RESERVATION
DEVELOPMENT

Area
Stamp
Drawing Number
P23
Author
B MAST



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K Provided by Kubota and installed by contractor

No.	Revision/Issue	Date
1	SHINGO KUBO	10.7.16

Drawing Name
P&ID
MEMBRANE
BIOREACTOR
TANK 2

Project Name and Address
WATER RECLAMATION
PLANT

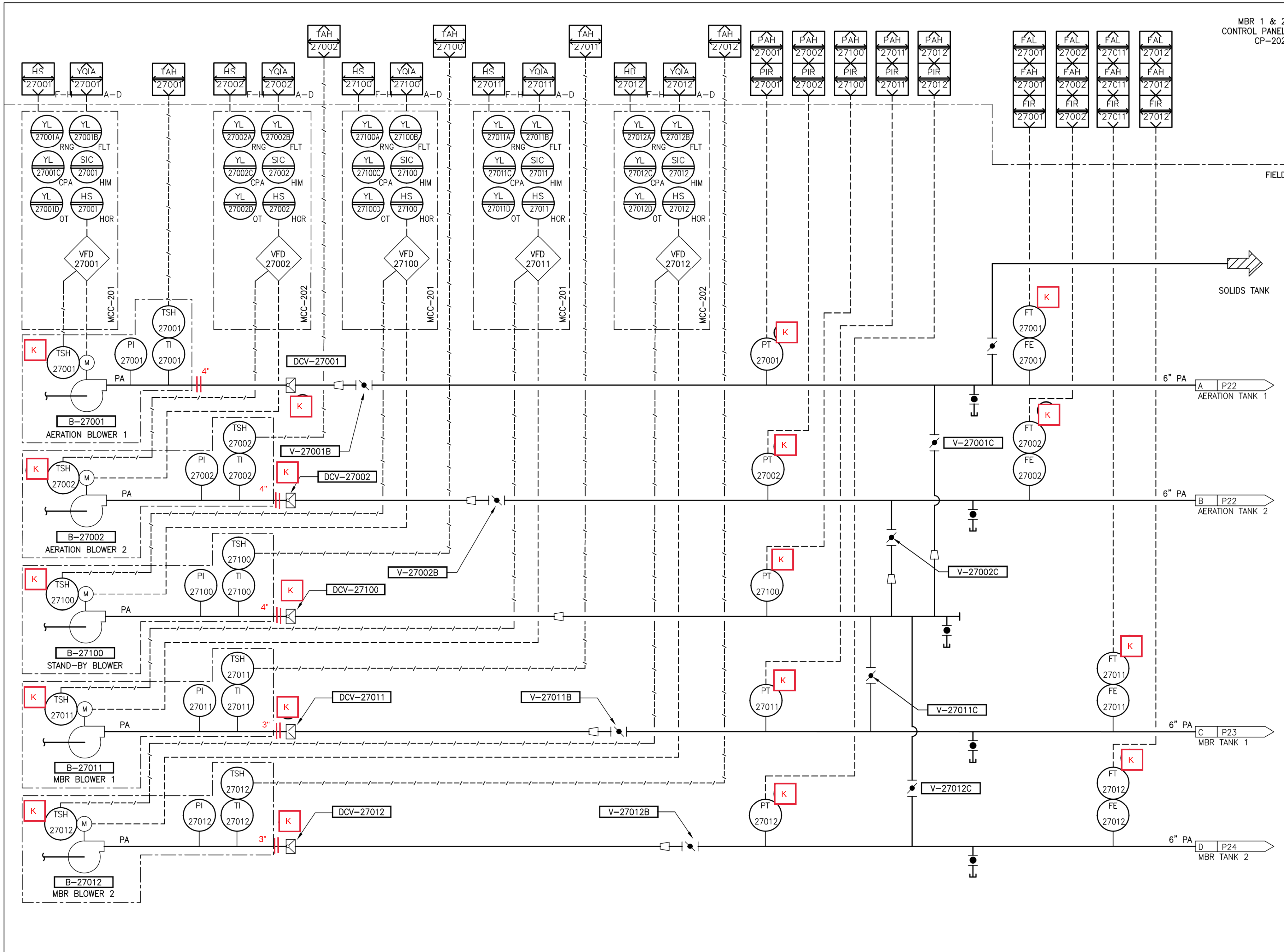
COWLITZ RESERVATION
DEVELOPMENT

Area

Stamp

Drawing Number
P24

Author
B MAST



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NOTES:

K SUPPLIED BY KUBOTA, INSTALLED BY OTHERS

No.	Revision/Issue	Date
1	SHINGO KUBO	10.7.16

Drawing Name
P&ID
AERATION AND
MBR BLOWERS

Project Name and Address
WATER RECLAMATION PLANT

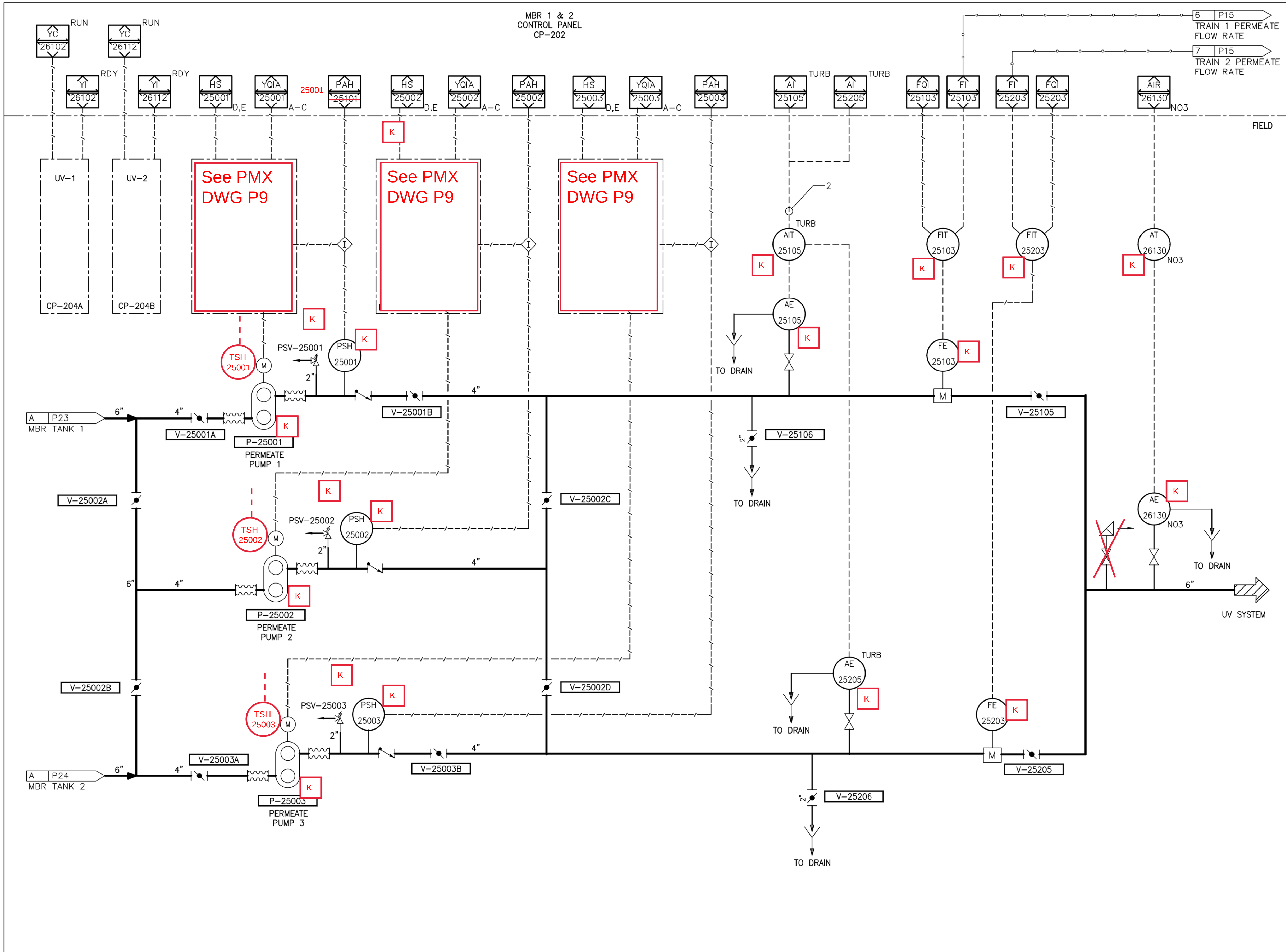
COWLITZ RESERVATION DEVELOPMENT

Area

Stamp

Drawing Number
P25

Author
B MAST



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2 CP-204A/204B SUPPLIED BY U.V. VENDOR

3 PUMPS AND INSTRUMENTATION SUPPLIED BY KUBOTA

4 PIPING AND VALVES SUPPLIED BY OTHERS

K Provided by Kubota and installed by contractor

No.	Revision/Issue	Date
1	SHINGO KUBO	10.7.16

Drawing Name

P&ID PERMEATE SYSTEM

Project Name and Address

WATER RECLAMATION PLANT

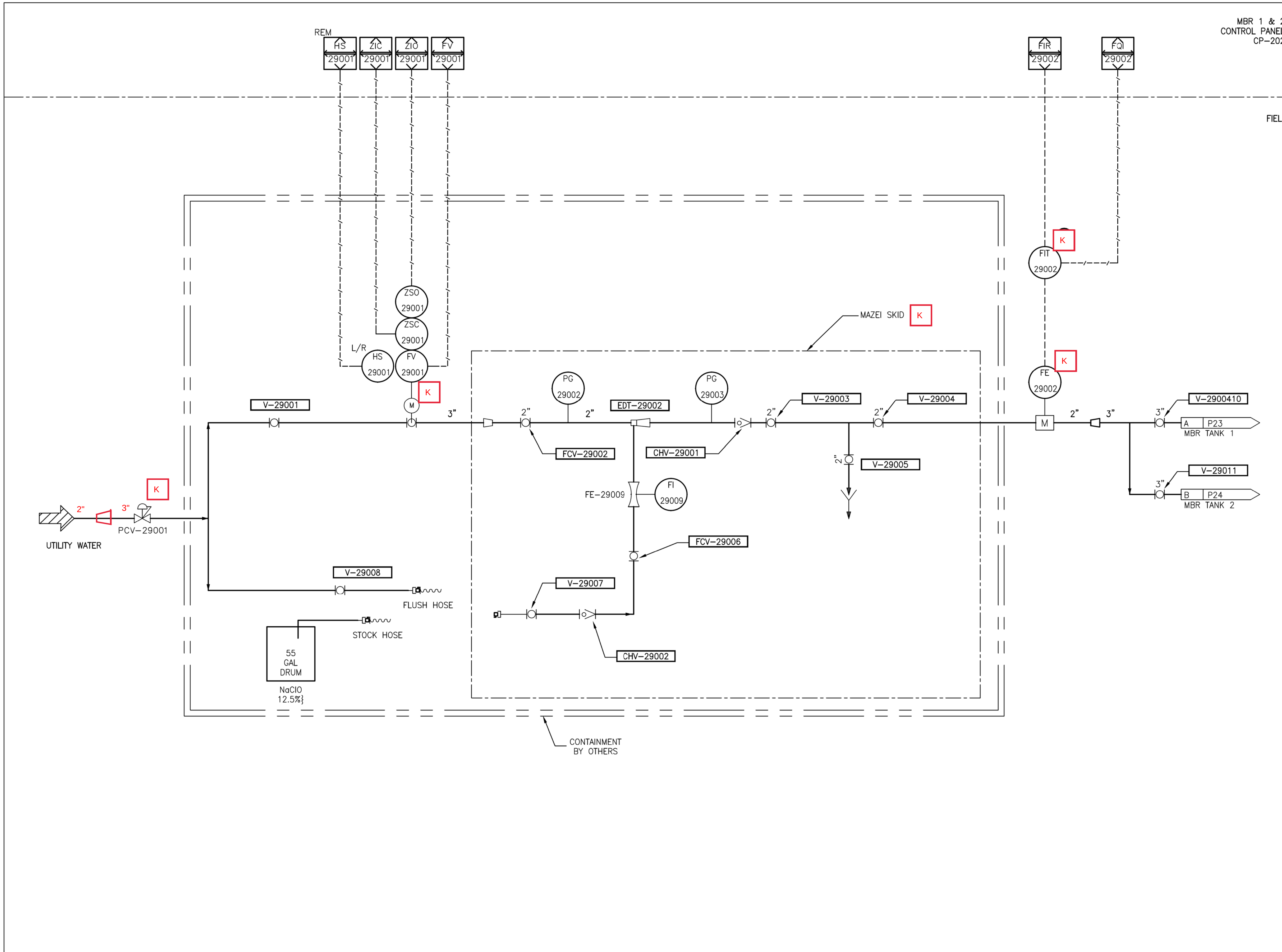
COWLITZ RESERVATION DEVELOPMENT

Area

Stamp

Drawing Number P26

Author B MAST



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3. ALL PIPING AND VALVES OUTSIDE MAZZEI SKID BY OTHERS, EXCEPT AS NOTED

K Provided by Kubota and installed by contractor

No.	Revision/Issue	Date
1	SHINGO KUBO	10.7.16

Drawing Name
P&ID
CLEAN-IN-PLACE
INJECTION SYSTEM

Project Name and Address
WATER RECLAMATION PLANT

COWLITZ RESERVATION DEVELOPMENT

Area

Stamp

Drawing Number
P27

Author
B MAST

Appendix C

Alarm List

Tag Name	Alarm Description
_Sys.SysOnline	System Online
Ab1AirFit._AlmChn.InAlarm	Aeration Basin 1 Air Flow IO Channel Alarm
Ab1AirFit._AlmHi.InAlarm	Aeration Basin 1 Air Flow Hi Alarm
Ab1AirFit._AlmHiHi.InAlarm	Aeration Basin 1 Air Flow Hi Hi Alarm
Ab1AirFit._AlmLo.InAlarm	Aeration Basin 1 Air Flow Lo Alarm
Ab1BlrTsh.In_Alarm	Aeration Blower 1 Enclosure Overtemp
Ab1Dot._AlmChn.InAlarm	Aeration Basin 1 Dissolved Oxygen IO Channel Alarm
Ab1Dot._AlmHi.InAlarm	Aeration Basin 1 Dissolved Oxygen Hi Alarm
Ab1Dot._AlmHiHi.InAlarm	Aeration Basin 1 Dissolved Oxygen Hi Hi Alarm
Ab1Dot._AlmLo.InAlarm	Aeration Basin 1 Dissolved Oxygen lo Alarm
Ab1Lah.In_Alarm	Aeration Basin 1 Low level Switch
Ab1Lal.In_Alarm	Aeration Basin 1 High level Switch
Ab1Lit._AlmChn.InAlarm	Aeration Basin 1 Level IO Channel Alarm
Ab1Lit._AlmHi.InAlarm	Aeration Basin 1 level Hi Alarm
Ab1Lit._AlmHiHi.InAlarm	Aeration Basin 1 Level Hi Hi Alarm
Ab1Lit._AlmLo.InAlarm	Aeration Basin 1 level lo Alarm
Ab1Mix.HMI_Auto	HMI in Auto
Ab1Mix.I_ControlFail	Aeration Tank 1 Mixer Control Fail
Ab1Mix.S_Fault	Aeration Tank 1 Mixer Fault
Ab1Mix.S_OverTemp	Aeration Tank 1 Mixer Overtemp Detected
Ab1Mix.S_SealFail	Aeration Tank 1 Mixer Seal Fail Detected
Ab1Tit._AlmChn.InAlarm	Aeration Basin 1 Temperature IO Channel Alarm
Ab1Tit._AlmHi.InAlarm	Aeration Basin 1 Temperature Hi Alarm
Ab1Tit._AlmHiHi.InAlarm	Aeration Basin 1 Temperature Hi Hi Alarm
Ab1Tit._AlmLo.InAlarm	Aeration Basin 1 Temperature Lo Alarm
Ab2AirFit._AlmChn.InAlarm	Aeration Basin 2 Air Flow IO Channel Alarm
Ab2AirFit._AlmHi.InAlarm	Aeration Basin 2 Air Flow Hi Alarm
Ab2AirFit._AlmHiHi.InAlarm	Aeration Basin 2 Air Flow Hi Hi Alarm
Ab2AirFit._AlmLo.InAlarm	Aeration Basin 2 Air Flow Lo Alarm
Ab2BlrTsh.In_Alarm	Aeration Blower 2 Enclosure Overtemp
Ab2Dot._AlmChn.InAlarm	Aeration Basin 2 Dissolved Oxygen 10 Channel Alarm
Ab2Dot._AlmHi.InAlarm	Aeration Basin 2 Dissolved Oxygen Hi Alarm
Ab2Dot._AlmHiHi.InAlarm	Aeration Basin 2 Dissolved Oxygen Hi Hi Alarm
Ab2Dot._AlmLo.InAlarm	Aeration Basin 2 Dissolved Oxygen Lo Alarm
Ab2Lah.In_Alarm	Aeration Basin 2 low level Switch
Ab2Lal.In_Alarm	Aeration Basin 2 High Level Switch
Ab2Lit._AlmChn.InAlarm	Aeration Basin 2 Level IO Channel Alarm
Ab2Lit._AlmHi.InAlarm	Aeration Basin 2 level Hi Alarm
Ab2Lit._AlmHiHi.InAlarm	Aeration Basin 2 Level Hi Hi Alarm
Ab2Lit._AlmLo.InAlarm	Aeration Basin 2 level Lo Alarm
Ab2Mix.HMI_Auto	HMI In Auto
Ab2Mix.I_ControlFail	Aeration Tank 2 Mixer Control Fail
Ab2Mix.S_Fault	Aeration Tank 2 Mixer Fault
Ab2Mix.S_OverTemp	Aeration Tank 2 Mixer Overtemp Detected
Ab2Mix.S_SealFail	Aeration Tank 2 Mixer Seal Fail Detected
Ab2Tit._AlmChn.InAlarm	Aeration Basin 2 Temperature IO Channel Alarm
Ab2Tit._AlmHi.InAlarm	Aeration Basin 2 Temperature Hi Alarm
Ab2Tit._AlmHiHi.InAlarm	Aeration Basin 2 Temperature Hi Hi Alarm
Ab2Tit._AlmLo.InAlarm	Aeration Basin 2 Temperature Lo Alarm
AbBlr1.HMI_Auto	HMI in Auto
AbBlr1.I_ControlFail	Aeration Blower 1 Control Fail
AbBlr1.S_Fault	Aeration Blower 1 Fault
AbBlr1.S_OverTemp	Aeration Blower 1 Overtemp Detected
AbBlr1.S_SealFail	Aeration Blower 1 Seal Fail Detected
AbBlr1Pit._AlmChn.InAlarm	Aeration Basin 1 Blower Header Pressure in IO Channel Alarm
AbBlr1Pit._AlmHi.InAlarm	Aeration Basin 1 Blower Header Pressure Hi
AbBlr1Pit._AlmHiHi.InAlarm	Aeration Basin 1 Blower Header Pressure Hi Hi
AbBlr1Pit._AlmLo.InAlarm	Aeration Basin 1 Blower Header Pressure Lo
AbBlr2.HMI_Auto	HMI in Auto
AbBlr2.I_ControlFail	Aeration Blower 2 Control Fail
AbBlr2.S_Fault	Aeration Blower 2 Fault
AbBlr2.S_OverTemp	Aeration Blower 2 Overtemp Detected
AbBlr2.S_SealFail	Aeration Blower 2 Seal Fail Detected

Tag Name	Alarm Description
AbBlr2Pit._AlmChn.InAlarm	Aeration Basin 2 Blower Header Pressure IO Channel Alarm
AbBlr2Pit._AlmHi.InAlarm	Aeration Basin 2 Blower Header Pressure Hi
AbBlr2Pit._AlmHiHi.InAlarm	Aeration Basin 2 Blower Header Pressure Hi Hi
AbBlr2Pit._AlmLo.InAlarm	Aeration Basin 2 Blower Header Pressure Lo
AppEngine_WRP.Running_On_Backup_Server	Backup Server Running
Ax1Dot._AlmChn.InAlarm	Anoxic Basin 1 Dissolved Oxygen IO Channel Alarm
Ax1Dot._AlmHi.InAlarm	Anoxic Basin 1 Dissolved Oxygen Hi Alarm
Ax1Dot._AlmHiHi.InAlarm	Anoxic Basin 1 Dissolved Oxygen Hi Hi Alarm
Ax1Dot._AlmLo.InAlarm	Anoxic Basin 1 Dissolved Oxygen Lo Alarm
Ax1Lah.In_Alarm	Anoxic Basin 1 Low Level Switch
Ax1Lal.In_Alarm	Anoxic Basin 1 High Level Switch
Ax1Lit._AlmChn.InAlarm	Anoxic Basin 1 Level IO Channel Alarm
Ax1Lit._AlmHi.InAlarm	Anoxic Basin 1 Level Hi Alarm
Ax1Lit._AlmHiHi.InAlarm	Anoxic Basin 1 Level Hi HI Alarm
Ax1Lit._AlmLo.InAlarm	Anoxic Basin 1 Level Lo Alarm
Ax1Mix.HMI_Auto	HMI In Auto
Ax1Mix.I_ControlFail	Anoxic Tank 1 Mixer Control Fail
Ax1Mix.S_Fault	Anoxic Tank 1 Mixer Fault
Ax1Mix.S_OverTemp	Anoxic Tank 1 Mixer Overtemp Detected
Ax1Mix.S_SealFail	Anoxic Tank 1 Mixer Seal Fail Detected
Ax1Orp._AlmChn.InAlarm	Anoxic Basin 1 Orp IO Channel Alarm
Ax1Orp._AlmHi.InAlarm	Anoxic Basin 1 Orp Hi Alarm
Ax1Orp._AlmHiHi.InAlarm	Anoxic Basin 1 Orp Hi Hi Alarm
Ax1Orp._AlmLo.InAlarm	Anoxic Basin 1 Orp Lo Alarm
Ax1Pht._AlmChn.InAlarm	Anoxic Basin 1 pH IO Channel Alarm
Ax1Pht._AlmHi.InAlarm	Anoxic Basin 1 pH Hi Alarm
Ax1Pht._AlmHiHi.InAlarm	Anoxic Basin 1 pH Hi Hi Alarm
Ax1Pht._AlmLo.InAlarm	Anoxic Basin 1 pH Lo Alarm
Ax1Tit._AlmChn.InAlarm	Anoxic Basin 1 Temperature IO Channel Alarm
Ax1Tit._AlmHi.InAlarm	Anoxic Basin 1 Temperature Hi Alarm
Ax1Tit._AlmHiHi.InAlarm	Anoxic Basin 1 Temperature Hi Hi Alarm
Ax1Tit._AlmLo.InAlarm	Anoxic Basin 1 Temperature Lo Alarm
Ax2Dot._AlmChn.InAlarm	Anoxic Basin 2 Dissolved Oxygen IO Channel Alarm
Ax2Dot._AlmHi.InAlarm	Anoxic Basin 2 Dissolved Oxygen Hi Alarm
Ax2Dot._AlmHiHi.InAlarm	Anoxic Basin 2 Dissolved Oxygen Hi Hi Alarm
Ax2Dot._AlmLo.InAlarm	Anoxic Basin 2 Dissolved Oxygen Lo Alarm
Ax2Lah.In_Alarm	Anoxic Basin 2 Low Level Switch
Ax2Lal.In_Alarm	Anoxic Basin 2 High level Switch
Ax2Lit._AlmChn.InAlarm	Anoxic Basin 2 Level IO Channel Alarm
Ax2Lit._AlmHi.InAlarm	Anoxic Basin 2 Level Hi Alarm
Ax2Lit._AlmHiHi.InAlarm	Anoxic Basin 2 Level Hi Hi Alarm
Ax2Lit._AlmLo.InAlarm	Anoxic Basin 2 Level Lo Alarm
Ax2Mix.HMI_Auto	HMI In Auto
Ax2Mix.I_ControlFail	Anoxic Tank 2 Mixer Control Fail
Ax2Mix.S_Fault	Anoxic Tank 2 Mixer Fault
Ax2Mix.S_OverTemp	Anoxic Tank 2 Mixer Overtemp Detected
Ax2Mix.S_SealFail	Anoxic Tank 2 Mixer Seal Fail Detected
Ax2Orp._AlmChn.InAlarm	Anoxic Basin 2 Orp IO Channel Alarm
Ax2Orp._AlmHi.InAlarm	Anoxic 8aSln 2 Orp Hi Alarm
Ax2Orp._AlmHiHi.InAlarm	Anoxic Basin 2 Orp Hi Hi Alarm
Ax2Orp._AlmLo.InAlarm	Anoxic Basin 2 Orp Lo Alarm
Ax2Pht._AlmChn.InAlarm	Anoxic Basin 2 pH IO Channel Alarm
Ax2Pht._AlmHi.InAlarm	Anoxic Basin 2 pH Hi Alarm
Ax2Pht._AlmHiHi.InAlarm	Anoxic Basin 2 pH Hi Hi Alarm
Ax2Pht._AlmLo.InAlarm	Anoxic Basin 2 pH Lo Alarm
Ax2Tit._AlmChn.InAlarm	Anoxic Basin 2 Temperature IO Channel Alarm
Ax2Tit._AlmHi.InAlarm	Anoxic Basin 2 Temperature Hi Alarm
Ax2Tit._AlmHiHi.InAlarm	Anoxic Basin 2 Temperature Hi Hi Alarm
Ax2Tit._AlmLo.InAlarm	Anoxic Basin 2 Temperature Lo Alarm
CipFit._AlmChn.InAlarm	CIP Solution Flow IO Channel Alarm
CipFit._AlmHi.InAlarm	CIP Solution Flow Hi Alarm
CipFit._AlmHiHi.InAlarm	CIP Solution Flow Hi Hi Alarm
CipFit._AlmLo.InAlarm	CIP Solution Flow Lo Alarm

Tag Name	Alarm Description
CipXv.Cmd_ClearFault	Clear Valve Fault
CipXv.I_ControlFail	CIP Valve Control Fail
CipXv.S_Fault	CIP Valve Fault
Cp202APwrSplyA.In_Alarm	CP202A 24VDC Power Supply A Status
Cp202APwrSplyB.In_Alarm	CP202A 24VDC Power Supply B Status
Cp202BPwrSplyA.In_Alarm	CP202B 24VDC Power Supply A Status
Cp202BPwrSplyB.In_Alarm	CP202B 24VDC Power Supply B Status
Cp202PwrSplyA.In_Alarm	CP202 24VDC Power Supply A Status
Cp202PwrSplyB.In_Alarm	CP202 24VDC Power Supply B Status
Cp202UpsBat.In_Alarm	CP202 UPS on Battery Power
Cp202UpsBatFlt.In_Alarm	CP202 UPS Battery Fault
Cp202UpsBatLow.In_Alarm	CP202 UPS Battery Low
Cp202UpsFlt.In_Alarm	CP202 UPS Fault
Cp202UpsOvld.In_Alarm	CP202 UPS Overload
DASABCIP_WRP.CP201_Main.ItemErrorCntAlarm	DISABLED
DASABCIP_WRP.CP202_MBR.ItemErrorCntAlarm	DISABLED
DASABCIP_WRP.CP210_HW.ItemErrorCntAlarm	DISABLED
ITViewApp_Cowlitz_Node_MBR.ItemErrorCntAlarm	DISABLED
ITViewApp_Cowlitz_Node_WRP.ItemErrorCntAlarm	DISABLED
IW125_1_DS26610_Disco.Alarm_On	Injection Well #1 Disconnect Open
IW125_2_DS26620_Disco.Alarm_On	Injection Well #2 Disconnect Open
IW125_2_FT26621.Alarm_H	Injection Well #2 Flow High Alarm
IW125_2_FT26621.Alarm_HH	Injection Well #2 Flow High-High Alarm
IW125_2_FT26621.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
IW125_2_FV26621.Close_Alarm	DISABLED
IW125_2_FV26621.Open_Alarm	DISABLED
IW125_2_FV26621.Pump_Start_Flt	DISABLED
IW125_2_LS26624_Flood.Alarm_On	Injection Well #2 Vault Flood
IW125_2_LT26623.Alarm_H	Injection Well #2 Well Level High Alarm
IW125_2_LT26623.Alarm_HH	Injection Well #2 Well Level High-High Alarm
IW125_2_LT26623.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
IW125_2_PT26622.Alarm_L	Injection Well #2 Supply Pressure Low Alarm
IW125_2_PT26622.Alarm_LL	Injection Well #2 Supply Pressure Low-Low Alarm
IW125_2_PT26622.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
IW125_2_ZS26625_Intruder.Alarm_On	Injection Well #2 Intrusion Switch
IW125_5_DS26650_Disco.Alarm_On	Injection Well #5 Disconnect Open
IW125_5_FT26651.Alarm_H	Injection Well #5 Flow High Alarm
IW125_5_FT26651.Alarm_HH	Injection Well #5 Flow High-High Alarm
IW125_5_FT26651.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
IW125_5_FV26651.Close_Alarm	DISABLED
IW125_5_FV26651.Open_Alarm	DISABLED
IW125_5_FV26651.Pump_Start_Flt	DISABLED
IW125_5_LS26654_Flood.Alarm_On	Injection Well #5 Vault Flood
IW125_5_LT26653.Alarm_H	Injection Well #5 Well Level High Alarm
IW125_5_LT26653.Alarm_HH	Injection Well #5 Well Level High-High Alarm
IW125_5_LT26653.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
IW125_5_PT26652.Alarm_L	Injection Well #5 Supply Pressure low Alarm
IW125_5_PT26652.Alarm_LL	Injection Well #5 Supply Pressure Low-Low Alarm
IW125_5_PT26652.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
IW125_5_ZS26655_Intruder.Alarm_On	Injection Well #5 Intrusion Switch
IW125_AC_Cntl_Power.Alarm_On	CP-261 AC Control Power Failure
IW125_DC_Cntl_Power.Alarm_On	CP-261 DC Control Power Failure
IW125_Panel_Intruder.Alarm_On	CP261 Panel Intrusion Switch
IW36_3_DS26630_Disco.Alarm_On	Injection Well #3 Disconnect Open
IW36_3_FT26631.Alarm_H	Injection Well #3 Flow High Alarm
IW36_3_FT26631.Alarm_HH	Injection Well #3 Flow High-High Alarm
IW36_3_FT26631.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
IW36_3_FV26631.Close_Alarm	DISABLED
IW36_3_FV26631.Open_Alarm	DISABLED
IW36_3_FV26631.Pump_Start_Flt	DISABLED
IW36_3_LS26634_Flood.Alarm_On	Injection Well #3 Vault Flood
IW36_3_LT26633.Alarm_H	Injection Well #3 Well Level High Alarm
IW36_3_LT26633.Alarm_HH	Injection Well #3 Well Level High-High Alarm

Tag Name	Alarm Description
IW36_3_LT26633.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
IW36_3_PT26632.Alarm_L	Injection Well #3 Supply Pressure Low Alarm
IW36_3_PT26632.Alarm_LL	Injection Well #3 Supply Pressure Low-Low Alarm
IW36_3_PT26632.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
IW36_3_ZS26635_Intruder.Alarm_On	Injection Well #3 Intrusion Switch
IW36_6_DS26660_Disco.Alarm_On	Injection Well #6 Disconnect Open
IW36_6_FT26661.Alarm_H	Injection Well #6 Flow High Alarm
IW36_6_FT26661.Alarm_HH	Injection Well #6 Flow High-High Alarm
IW36_6_FT26661.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
IW36_6_FV26661.Close_Alarm	DISABLED
IW36_6_FV26661.Open_Alarm	DISABLED
IW36_6_FV26661.Pump_Start_Flt	DISABLED
IW36_6_LS26664_Flood.Alarm_On	Injection Well #6 Vault Flood
IW36_6_LT26663.Alarm_H	Injection Well #6 Well level High Alarm
IW36_6_LT26663.Alarm_HH	Injection Well #6 Well level High-High Alarm
IW36_6_LT26663.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
IW36_6_PT26662.Alarm_L	Injection Well #6 Supply Pressure Low Alarm
IW36_6_PT26662.Alarm_LL	Injection Well #6 Supply Pressure Low-Low Alarm
IW36_6_PT26662.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
IW36_6_ZS26665_Intruder.Alarm_On	Injection Well #6 Intrusion Switch
IW36_AC_Cntl_Power.Alarm_On	CP-262 AC Control Power Failure
IW36_DC_Cntl_Power.Alarm_On	CP-262 DC Control Power Failure
IW36_Panel_Intruder.Alarm_On	CP262 Panel Intrusion Switch
IW47_4_DS26640_Disco.Alarm_On	Injection Well #4 Disconnect Open
IW47_4_FT26641.Alarm_H	Injection Well #4 Flow High Alarm
IW47_4_FT26641.Alarm_HH	Injection Well #4 Flow High-High Alarm
IW47_4_FT26641.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
IW47_4_FV26641.Close_Alarm	DISABLED
IW47_4_FV26641.Open_Alarm	DISABLED
IW47_4_FV26641.Pump_Start_Flt	DISABLED
IW47_4_LS26644_Flood.Alarm_On	Injection Well #4 Vault Flood
IW47_4_LT26643.Alarm_H	Injection Well #4 Well level High Alarm
IW47_4_LT26643.Alarm_HH	Injection Well #4 Well level High-High Alarm
IW47_4_LT26643.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
IW47_4_PT26642.Alarm_L	Injection Well #4 Supply Pressure Low Alarm
IW47_4_PT26642.Alarm_LL	Injection Well #4 Supply Pressure Low-Low Alarm
IW47_4_PT26642.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
IW47_4_ZS26645_Intruder.Alarm_On	Injection Well #4 Intrusion Switch
IW47_7_DS26670_Disco.Alarm_On	Injection Well #7 Disconnect Open
IW47_7_FT26671.Alarm_H	Injection Well #7 Flow High Alarm
IW47_7_FT26671.Alarm_HH	Injection Well #7 Flow High-High Alarm
IW47_7_FT26671.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
IW47_7_FV26671.Close_Alarm	DISABLED
IW47_7_FV26671.Open_Alarm	DISABLED
IW47_7_FV26671.Pump_Start_Flt	DISABLED
IW47_7_LS26674_Flood.Alarm_On	Injection Well #7 Vault Flood
IW47_7_LT26673.Alarm_H	Injection Well #7 Well level High Alarm
IW47_7_LT26673.Alarm_HH	Injection Well #7 Well level High-High Alarm
IW47_7_LT26673.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
IW47_7_PT26672.Alarm_L	Injection Well #7 Supply Pressure Low Alarm
IW47_7_PT26672.Alarm_LL	Injection Well #7 Supply Pressure Low-Low Alarm
IW47_7_PT26672.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
IW47_7_ZS26675_Intruder.Alarm_On	Injection Well #7 Intrusion Switch
IW47_AC_Cntl_Power.Alarm_On	CP-263 AC Control Power Failure
IW47_DC_Cntl_Power.Alarm_On	CP-263 DC Control Power Failure
IW47_Panel_Intruder.Alarm_On	CP263 Panel Intrusion Switch
Mbr1.DutyBlower.Ready	Mbr1 Duty Blower Not Ready
Mbr1AirFit._AlmChn.InAlarm	Mbr Basin 1 Air Flow IO Channel Alarm
Mbr1AirFit._AlmHi.InAlarm	Mbr Basin 1 Air Flow Hi Alarm
Mbr1AirFit._AlmHiHi.InAlarm	Mbr Basin 1 Air Flow Hi Hi Alarm
Mbr1AirFit._AlmLo.InAlarm	Mbr Basin 1 Air Flow Lo Alarm
Mbr1AvgFlux._AlmChn.InAlarm	Mbr1 Average Flux IO Channel Alarm
Mbr1AvgFlux._AlmHi.InAlarm	Mbr1 Average Flux Hi Alarm

Tag Name	Alarm Description
Mbr1AvgFlux._AlmHiHi.InAlarm	Mbr1 Average Flux Hi Hi Alarm
Mbr1AvgFlux._AlmLo.InAlarm	Mbr1 Average Flux Lo Alarm
Mbr1BlrTsh.In_Alarm	Mbr Blower 2 Enclosure Overtemp
Mbr1DeGasXv.Cmd_ClearFault	Clear Valve Fault
Mbr1DeGasXv.I_ControlFail	Mbr1 Degas Valve Control Fail
Mbr1DeGasXv.S_Fault	Mbr1 Degas Valve Fault
Mbr1DifClnXv.Cmd_ClearFault	Clear Valve Fault
Mbr1DifClnXv.I_ControlFail	Mbr 1 Diff Cln Vlv Control Fail
Mbr1DifClnXv.S_Fault	Mbr 1 Diff Cln Vlv Fault
Mbr1Flux._AlmChn.InAlarm	Mbr 1 Flux IO Channel Alarm
Mbr1Flux._AlmHi.InAlarm	Mbr 1 Flux Hi Alarm
Mbr1Flux._AlmHiHi.InAlarm	Mbr 1 Flux Hi Hi Alarm
Mbr1Flux._AlmLo.InAlarm	Mbr 1 Flux Lo Alarm
Mbr1Lah.In_Alarm	Mbr Basin 1 High Level Switch
Mbr1Lal.In_Alarm	Mbr Basin 1 Low Level Switch
Mbr1Lit._AlmChn.InAlarm	Mbr 1 Basin Level IO Channel Alarm
Mbr1Lit._AlmHi.InAlarm	Mbr 1 Basin Level Hi Alarm
Mbr1Lit._AlmHiHi.InAlarm	Mbr 1 Basin Level Hi Hi Alarm
Mbr1Lit._AlmLo.InAlarm	Mbr 1 Basin Level Lo Alarm
Mbr1NetFlux._AlmChn.InAlarm	Mbr 1 Average Flux IO Channel Alarm
Mbr1NetFlux._AlmHi.InAlarm	Mbr 1 Average Flux Hi Alarm
Mbr1NetFlux._AlmHiHi.InAlarm	Mbr 1 Average Flux Hi Hi Alarm
Mbr1NetFlux._AlmLo.InAlarm	Mbr 1 Average Flux Lo Alarm
Mbr1Prm.DutyPump.Ready	Mbr 1 Permeate Duty Pump Not Ready
Mbr1Prmblty._AlmChn.InAlarm	Mbr 1 Permeability IO Channel Alarm
Mbr1Prmblty._AlmHi.InAlarm	Mbr 1 Permeability Hi Alarm
Mbr1Prmblty._AlmHiHi.InAlarm	Mbr 1 Permeability Hi Hi Alarm
Mbr1Prmblty._AlmLo.InAlarm	Mbr 1 Permeability Lo Alarm
Mbr1PrmFit._AlmChn.InAlarm	Mbr 1 Permeate Flow IO Channel Alarm
Mbr1PrmFit._AlmHi.InAlarm	Mbr 1 Permeate Flow Hi Alarm
Mbr1PrmFit._AlmHiHi.InAlarm	Mbr 1 Permeate Flow Hi Hi Alarm
Mbr1PrmFit._AlmLo.InAlarm	Mbr 1 Permeate Flow Lo Alarm
Mbr1PrmPit._AlmChn.InAlarm	Mbr 1 Permeate Header Pressure IO Channel Alarm
Mbr1PrmPit._AlmHi.InAlarm	Mbr 1 Permeate Header Pressure Hi Alarm
Mbr1PrmPit._AlmHiHi.InAlarm	Mbr 1 Permeate Header Pressure Hi Hi Alarm
Mbr1PrmPit._AlmLo.InAlarm	Mbr 1 Permeate Header Pressure Lo Alarm
Mbr1PrmTrb._AlmChn.InAlarm	Mbr 1 Permeate Turbidity IO Channel Alarm
Mbr1PrmTrb._AlmHi.InAlarm	Mbr 1 Permeate Turbidity Hi Alarm
Mbr1PrmTrb._AlmHiHi.InAlarm	Mbr 1 Permeate Turbidity Hi Hi Alarm
Mbr1PrmTrb._AlmLo.InAlarm	Mbr 1 Permeate Turbidity Lo Alarm
Mbr1Tmp._AlmChn.InAlarm	Mbr 1 Trans Membrane Pressure IO Channel
Mbr1Tmp._AlmHi.InAlarm	Mbr 1 Trans Membrane Pressure Hi Alarm
Mbr1Tmp._AlmHiHi.InAlarm	Mbr 1 Trans Membrane Pressure Hi Hi Alarm
Mbr1Tmp._AlmLo.InAlarm	Mbr 1 Trans Membrane Pressure Lo Alarm
Mbr2.DutyBlower.Ready	Mbr2 Duty Blower Not Ready
Mbr2AirFit._AlmChn.InAlarm	Mbr Basin 2 Air Flow IO Channel Alarm
Mbr2AirFit._AlmHi.InAlarm	Mbr Basin 2 Air Flow Hi Alarm
Mbr2AirFit._AlmHiHi.InAlarm	Mbr Basin 2 Air Flow Hi Hi Alarm
Mbr2AirFit._AlmLo.InAlarm	Mbr Basin 2 Air Flow Lo Alarm
Mbr2AvgFlux._AlmChn.InAlarm	Mbr2 Average Flux IO Channel Alarm
Mbr2AvgFlux._AlmHi.InAlarm	Mbr2 Average Flux Hi Alarm Alarm
Mbr2AvgFlux._AlmHiHi.InAlarm	Mbr2 Average Flux Hi Hi Alarm
Mbr2AvgFlux._AlmLo.InAlarm	Mbr2 Average Flux Lo Alarm
Mbr2BlrTsh.In_Alarm	Mbr Blower 2 Enclosure Overtemp
Mbr2DeGasXv.Cmd_ClearFault	Clear Valve Fault
Mbr2DeGasXv.I_ControlFail	Mbr2 Degas Valve Control Fail
Mbr2DeGasXv.S_Fault	Mbr2 Degas Valve Fault
Mbr2DifClnXv.Cmd_ClearFault	Clear Valve Fault
Mbr2DifClnXv.I_ControlFail	Mbr2 Diff Cln Vlv Control Fail
Mbr2DifClnXv.S_Fault	Mbr2 Diff Cln Vlv Fault
Mbr2Flux._AlmChn.InAlarm	Mbr2 Flux IO Channel Alarm
Mbr2Flux._AlmHi.InAlarm	Mbr2 Flux Hi Alarm
Mbr2Flux._AlmHiHi.InAlarm	Mbr2 Flux Hi HI Alarm

Tag Name	Alarm Description
Mbr2Flux._AlmLo.InAlarm	Mbr2 Flux Lo Alarm
Mbr2Lah.In_Alarm	Mbr Basin 2 High Level Switch
Mbr2Lal.In_Alarm	Mbr Basin 2 Low Level Switch
Mbr2Lit._AlmChn.InAlarm	Mbr2 Basin Level IO Channel Alarm
Mbr2Lit._AlmHi.InAlarm	Mbr2 Basin Level Hi Alarm
Mbr2Lit._AlmHiHi.InAlarm	Mbr2 Basin Level Hi Hi Alarm
Mbr2Lit._AlmLo.InAlarm	Mbr2 Basin Level Lo Alarm
Mbr2NetFlux._AlmChn.InAlarm	Mbr2 Average Flux IO Channel Alarm
Mbr2NetFlux._AlmHi.InAlarm	Mbr2 Average Flux Hi Alarm
Mbr2NetFlux._AlmHiHi.InAlarm	Mbr2 Average Flux Hi Hi Alarm
Mbr2NetFlux._AlmLo.InAlarm	Mbr2 Average Flux Lo Alarm
Mbr2Prm.DutyPump.Ready	Mbr2 Permeate Duty Pump Not Ready
Mbr2PrmBlty._AlmChn.InAlarm	Mbr2 Permeability IO Channel Alarm
Mbr2PrmBlty._AlmHi.InAlarm	Mbr2 Permeability Hi Alarm
Mbr2PrmBlty._AlmHiHi.InAlarm	Mbr2 Permeability Hi Hi Alarm
Mbr2PrmBlty._AlmLo.InAlarm	Mbr2 Permeability Lo Alarm
Mbr2PrmFit._AlmChn.InAlarm	Mbr2 Permeate Row IO Channel Alarm
Mbr2PrmFit._AlmHi.InAlarm	Mbr2 Permeate Row Hi Alarm
Mbr2PrmFit._AlmHiHi.InAlarm	Mbr2 Permeate Row Hi Hi Alarm
Mbr2PrmFit._AlmLo.InAlarm	Mbr2 Permeate Row Lo Alarm
Mbr2PrmPit._AlmChn.InAlarm	Mbr2 Permeate Header Pressure IO Channel Alarm
Mbr2PrmPit._AlmHi.InAlarm	Mbr2 Permeate Header Pressure Hi Alarm
Mbr2PrmPit._AlmHiHi.InAlarm	Mbr2 Permeate Header Pressure Hi Hi Alarm
Mbr2PrmPit._AlmLo.InAlarm	Mbr2 Permeate Header Pressure Lo Alarm
Mbr2PrmTrb._AlmChn.InAlarm	Mbr2 Permeate Turbidity IO Channel Alarm
Mbr2PrmTrb._AlmHi.InAlarm	Mbr2 Permeate Turbidity Hi Alarm
Mbr2PrmTrb._AlmHiHi.InAlarm	Mbr2 Permeate Turbidity Hi Hi Alarm
Mbr2PrmTrb._AlmLo.InAlarm	Mbr2 Permeate Turbidity Lo Alarm
Mbr2Tmp._AlmChn.InAlarm	Mbr2 Trans Membrane Pressure IO Channel Alarm
Mbr2Tmp._AlmHi.InAlarm	Mbr2 Trans Membrane Pressure Hi Alarm
Mbr2Tmp._AlmHiHi.InAlarm	Mbr2 Trans Membrane Pressure Hi Hi Alarm
Mbr2Tmp._AlmLo.InAlarm	Mbr2 Trans Membrane Pressure Lo Alarm
MbrBlr1.HMI_Auto	HMI In Auto
MbrBlr1.I_ControlFail	Mbr Blower 1 Control Fail
MbrBlr1.S_Fault	Mbr Blower 1 Fault
MbrBlr1.S_OverTemp	Mbr Blower 1 Overtemp Detected
MbrBlr1.S_SealFail	Mbr Blower 1 Seal Fail Detected
MbrBlr1Pit._AlmChn.InAlarm	Mbr1 Blower Header Pressure IO Channel Alarm
MbrBlr1Pit._AlmHi.InAlarm	Mbr1 Blower Header Pressure Hi Alarm
MbrBlr1Pit._AlmHiHi.InAlarm	Mbr1 Blower Header Pressure Hi Hi Alarm
MbrBlr1Pit._AlmLo.InAlarm	Mbr1 Blower Header Pressure Lo Alarm
MbrBlr2.HMI_Auto	HMI In Auto
MbrBlr2.I_ControlFail	Mbr Blower 2 Control Fail
MbrBlr2.S_Fault	Mbr Blower 2 Fault
MbrBlr2.S_OverTemp	Mbr Blower 2 Overtemp Detected
MbrBlr2.S_SealFail	Mbr Blower 2 Seal Fail Detected
MbrBlr2Pit._AlmChn.InAlarm	Mbr2 Blower Header Pressure IO Channel Alarm
MbrBlr2Pit._AlmHi.InAlarm	Mbr2 Blower Header Pressure Hi Alarm
MbrBlr2Pit._AlmHiHi.InAlarm	Mbr2 Blower Header Pressure Hi Hi Alarm
MbrBlr2Pit._AlmLo.InAlarm	Mbr2 Blower Header Pressure Lo Alarm
MbrPrmNo3._AlmChn.InAlarm	Mbr Permeate N03 IO Channel Alarm
MbrPrmNo3._AlmHi.InAlarm	Mbr Permeate N03 Hi Alarm
MbrPrmNo3._AlmHiHi.InAlarm	Mbr Permeate N03 Hi Hi Alarm
MbrPrmNo3._AlmLo.InAlarm	Mbr Permeate N03 Lo Alarm
PrmPmp1.HMI_Auto	HMI In Auto
PrmPmp1.I_ControlFail	Permeate Pump 1 Control Fail
PrmPmp1.S_Fault	Permeate Pump 1 Fault
PrmPmp1.S_OverTemp	Permeate Pump 1 Overtemp Detected
PrmPmp1.S_SealFail	Permeate Pump 1 Seal Fail Detected
PrmPmp1Psh.In_Alarm	Permeate Pump 1 High Pressure Switch
PrmPmp2.HMI_Auto	HMI In Auto
PrmPmp2.I_ControlFail	Permeate Pump 2 Control Fail
PrmPmp2.S_Fault	Permeate Pump 2 Fault

Tag Name	Alarm Description
PrmPmp2.S_OverTemp	Permeate Pump 2 Overtemp Detected
PrmPmp2.S_SealFail	Permeate Pump 2 Seal Fail Detected
PrmPmp2Psh.In_Alarm	Permeate Pump 2 High Pressure Switch
PrmPmp3.HMI_Auto	HMI In Auto
PrmPmp3.I_ControlFail	Permeate Pump 3 Control Fail
PrmPmp3.S_Fault	Permeate Pump 3 Fault
PrmPmp3.S_OverTemp	Permeate Pump 3 Overtemp Detected
PrmPmp3.S_SealFail	Permeate Pump 3 Seal Fail Detected
PrmPmp3Psh.In_Alarm	Permeate Pump 3 High Pressure Switch
Ras1Fit._AlmChn.InAlarm	Feed Forward Flow to Aeration Basin 1 IO Channel Alarm
Ras1Fit._AlmHi.InAlarm	Feed Forward Flow to Aeration Basin 1 Hi Alarm
Ras1Fit._AlmHiHi.InAlarm	Feed Forward Flow to Aeration Basin 1 Hi Hi Alarm
Ras1Fit._AlmLo.InAlarm	Feed Forward Flow to Aeration Basin 1 Lo Alarm
Ras2Fit._AlmChn.InAlarm	Feed Forward Flow to Splitter Channel IO Alarm
Ras2Fit._AlmHi.InAlarm	Feed Forward Flow to Splitter Channel Hi Alarm
Ras2Fit._AlmHiHi.InAlarm	Feed Forward Flow to Splitter Channel Hi Hi Alarm
Ras2Fit._AlmLo.InAlarm	Feed Forward Flow to Splitter Channel Lo Alarm
Ras3Fit._AlmChn.InAlarm	Feed Forward Flow to Aeration Basin 2 IO Channel Alarm
Ras3Fit._AlmHi.InAlarm	Feed Forward Flow to Aeration Basin 2 Hi Alarm
Ras3Fit._AlmHiHi.InAlarm	Feed Forward Flow to Aeration Basin 2 Hi Hi Alarm
Ras3Fit._AlmLo.InAlarm	Feed Forward Flow to Aeration Basin 2 Lo Alarm
RasPmp1.HMI_Auto	HMI In Auto
RasPmp1.I_ControlFail	Feed Forward Pump 1 Control Fail
RasPmp1.S_Fault	Feed Forward Pump 1 Fault
RasPmp1.S_OverTemp	Feed Forward Pump 1 Overtemp Detected
RasPmp1.S_SealFail	Feed Forward Pump 1 Seal Fail Detected
RasPmp2.HMI_Auto	HMI In Auto
RasPmp2.I_ControlFail	Feed Forward Pump 2 Control Fail
RasPmp2.S_Fault	Feed Forward Pump 2 Fault
RasPmp2.S_OverTemp	Feed Forward Pump 2 Overtemp Detected
RasPmp2.S_SealFail	Feed Forward Pump 2 Seal Fail Detected
RasPmp3.HMI_Auto	HMI In Auto
RasPmp3.I_ControlFail	Feed Forward Pump 3 Control Fail
RasPmp3.S_Fault	Feed Forward Pump 3 Fault
RasPmp3.S_OverTemp	Feed Forward Pump 3 Overtemp Detected
RasPmp3.S_SealFail	Feed Forward Pump 3 Seal Fail Detected
StbyBlr.HMI_Auto	HMI In Auto
StbyBlr.I_ControlFail	Standby Blower Control Fail
StbyBlr.S_Fault	Standby Blower Fault
StbyBlr.S_OverTemp	Standby Blower Overtemp Detected
StbyBlr.S_SealFail	Standby Blower Seal Fail Detected
StbyBlrPit._AlmChn.InAlarm	Standby Blower Header Pressure IO Channel Alarm
StbyBlrPit._AlmHi.InAlarm	Standby Blower Header Pressure Hi Alarm
StbyBlrPit._AlmHiHi.InAlarm	Standby Blower Header Pressure Hi Hi Alarm
StbyBlrPit._AlmLo.InAlarm	Standby Blower Header Pressure Lo Alarm
Surge_NC.In_Alarm	CP202 Surge Suppressor Fault NC
Surge_NO.In_Alarm	CP202 Surge Suppressor Fault NO
Train1Ras.DutyPump.Ready	Train 1 Ras Pump Not Ready
Train2Ras.DutyPump.Ready	Train 2 Ras Pump Not Ready
WIN911.WIN911_HW_Generator_Alarm	Generator Alarm
WIN911.WIN911_HW_Generator_Running	Generator Running Alarm
WinPlatform_COWAOS1.CheckpointFileCorruptionAlarm	File Corruption Alarm
WinPlatform_COWAOS1.DiskSpaceFreeLoAlarm	Disk Space Alarm
WinPlatform_COWAOS2.CheckpointFileCorruptionAlarm	File Corruption Alarm
WinPlatform_COWAOS2.DiskSpaceFreeLoAlarm	Disk Space Alarm
WinPlatform_HMI.CheckpointFileCorruptionAlarm	File Corruption Alarm
WinPlatform_HMI.DiskSpaceFreeLoAlarm	Disk Space Alarm
WinPlatform_MBR.CheckpointFileCorruptionAlarm	File Corruption Alarm
WinPlatform_MBR.DiskSpaceFreeLoAlarm	Disk Space Alarm
WRPHW_AX28100_Gen.Gen_Day_Fuel_Low	Standby Generator Fuel Low
WRPHW_AX28100_Gen.Gen_Fuel_Leak_Day	Standby Generator Fuel Leak
WRPHW_AX28100_Gen.Gen_NOT_Auto	Standby Generator Not in Auto
WRPHW_AX28100_Gen.Gen_Running	Standby Generator Running

Tag Name	Alarm Description
WRPHW_AX28100_Gen.Gen_Shutdown_Alarm	Standby Generator Shutdown Alarm
WRPHW_AX28100_Gen.Gen_Warning	Standby Generator Warning
WRPHW_AX28108_Gen_Door.Alarm_On	Standby Generator Access Intrusion Switch
WRPHW_CP210_120VAC_Fail.Alarm_On	Loss of 120VAC Control Power in cabinet CP210
WRPHW_CP210_24VDC_1_Fail.Alarm_On	Loss of 24VDC from Power Supply #1 in cabinet CP210
WRPHW_CP210_24VDC_2_Fail.Alarm_On	Loss of 24VDC from Power Supply #2 in cabinet CP210
WRPHW_CP210_UPS_Fail.Alarm_On	UPS faulted in cabinet CP-210
WRPHW_FS_Enet_Rd_Flt.Alarm_On	Headworks to Fine Screen Read Messaging Alarm
WRPHW_FS_Enet_Wr_Flt.Alarm_On	Headworks to Fine Screen Write Messaging Alarm
WRPHW_FT20220_Influent.Xmitter_Fault	Analog Signal from Transmitter is outside Fault
WRPHW_LSH_20300A_Inf_PS_Lev_H.Alarm_On	Influent Pump Station Wet Well Level High
WRPHW_LSL_20300B_Inf_PS_Lev_L.Alarm_On	Influent Pump Station Wet Well Level Low
WRPHW_LT20300_Delta_Alarm.Alarm_On	EQ Tank Level Transmitters delta outside Fault
WRPHW_LT20300_Influent_Wet_Well.Alarm_HH	Influent Wet Well Level Hi Hi Alarm
WRPHW_LT20300_Influent_Wet_Well.Alarm_LL	Influent Wet Well Level Lo Lo Alarm
WRPHW_LT20300_Influent_Wet_Well.Xmitter_Fault	Analog Signal from Transmitter is outside Fault
WRPHW_LT20301_Sig_Status.Alarm_On	Influent Level LT20301 Transducer Signal
WRPHW_LT20302_Sig_Status.Alarm_On	Influent Level LT20302 Transducer Signal
WRPHW_P20301_Influent_P1.CntlPwr	Influent Pump 1 -NO Control Power at VFD
WRPHW_P20301_Influent_P1.Fault	Influent Pump 1 -General Fault
WRPHW_P20301_Influent_P1.HMI_Auto	Influent Pump 1 -NOT in HMI Auto
WRPHW_P20301_Influent_P1.OvrTemp	Influent Pump 1 - Motor Over Temp
WRPHW_P20301_Influent_P1.Remote_Out	Influent Pump 1 - VFD not available for Remote
WRPHW_P20301_Influent_P1.Seal_Fail	Influent Pump 1 - Moisture Detected in Motor
WRPHW_P20301_Influent_P1.Start_Fault	Influent Pump 1 - Motor Failed to Start
WRPHW_P20301_Influent_P1.VFDFault	Influent Pump 1 - VFD Fault
WRPHW_P20302_Influent_P2.CntlPwr	Influent Pump 2 - NO Control Power at VFD
WRPHW_P20302_Influent_P2.Fault	Influent Pump 2 - General Fault
WRPHW_P20302_Influent_P2.HMI_Auto	Influent Pump 2 - NOT in HMI Auto
WRPHW_P20302_Influent_P2.OvrTemp	Influent Pump 2 - Motor Over Temp
WRPHW_P20302_Influent_P2.Remote_Out	Influent Pump 2 - VFD not available for Remote
WRPHW_P20302_Influent_P2.Seal_Fail	Influent Pump 2 - Moisture Detected in Motor
WRPHW_P20302_Influent_P2.Start_Fault	Influent Pump 2 - Motor Failed to Start
WRPHW_P20302_Influent_P2.VFDFault	Influent Pump 2 - VFD Fault
WRPHW_P20303_Influent_P3.CntlPwr	Influent Pump 3 - NO Control Power at VFD
WRPHW_P20303_Influent_P3.Fault	Influent Pump 3 - General Fault
WRPHW_P20303_Influent_P3.HMI_Auto	Influent Pump 3 - NOT in HMI Auto
WRPHW_P20303_Influent_P3.OvrTemp	Influent Pump 3 - Motor Over Temp
WRPHW_P20303_Influent_P3.Remote_Out	Influent Pump 3 - VFD not available for Remote
WRPHW_P20303_Influent_P3.Seal_Fail	Influent Pump 3 - Moisture Detected in Motor
WRPHW_P20303_Influent_P3.Start_Fault	Influent Pump 3 - Motor Failed to Start
WRPHW_P20303_Influent_P3.VFDFault	Influent Pump 3 - VFD Fault
WRPHW_SC20111_Fine_Scr_1.Fault	Fine Screen #1 Faulted
WRPHW_SC20111_Fine_Scr_1.Hi_Lev_Loc	Fine Screen High Level from local source
WRPHW_SC20111_Fine_Scr_1.Hi_Lev_Rem	Fine Screen High Level from remote source
WRPHW_SC20121_Fine_Scr_2.Fault	Fine Screen #2 Faulted
WRPHW_SC20121_Fine_Scr_2.Hi_Lev_Loc	Fine Screen High Level from local source
WRPHW_SC20121_Fine_Scr_2.Hi_Lev_Rem	Fine Screen High Level from remote source
WRPHW_ZS20302_Infl_WW_Hatch.Alarm_On	Influent Pump Station Wet Well Hatch lntrusion
WRPHW_ZS20302D_Infl_Vlve_Hatch.Alarm_On	Influent Pump Station Valve Vault Hatch Intrusion
WRPHW_ZS21000A_HW_Elec_Dr.Alarm_On	HW Bldg. Electrical Room Door lntrusion Switch
WRPM_AT26541_CL2_Analyzer.Alarm_HH	Injection Pump Station CL2 Analyzer High-High Alarm
WRPM_AT26541_CL2_Analyzer.Alarm_LL	Injection Pump Station CL2 Analyzer Low-Low Alarm
WRPM_AT26541_CL2_Analyzer.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
WRPM_AX28000_ATS.ATS_Power_Fail	Loss of Utility Power
WRPM_B27804_Solids_Blower.CntlPwr	Solids Blower -NO Control Power at Motor
WRPM_B27804_Solids_Blower.Fault	Solids Blower -General Fault
WRPM_B27804_Solids_Blower.HMI_Auto	Solids Blower -NOT in HMI Auto
WRPM_B27804_Solids_Blower.Remote_Out	Solids Blower -Pump not available for Remote
WRPM_B27804_Solids_Blower.Start_Fault	Solids Blower -Motor Failed to Start
WRPM_CP201_120VAC_Fail.Alarm_On	120 VAC Control Power Failure
WRPM_CP201_24VDC_1_Fail.Alarm_On	Loss of 24VDC from Power Supply #1 in cabinet CP201
WRPM_CP201_24VDC_2_Fail.Alarm_On	Loss of 24VDC from Power Supply #2 in cabinet CP201

Tag Name	Alarm Description
WRPM_CP201_UPS_Fail.Alarm_On	UPS Failure
WRPM_CP204B_UV.Fault	UV Stream 2 - UV System Faulted
WRPM_CP204B_UV.Flow_Fail_Alarm	UV Stream 2 - Stream Alarm Flow Range Fault
WRPM_CP204B_UV.Flow_Fail_Warn	UV Stream 2 - Stream Alarm Flow Range Fault
WRPM_CP204B_UV.Flow_Sens_Fail_Alarm	UV Stream 2 - Stream Alarm Flow Sensor Fault
WRPM_CP204B_UV.Flow_Sens_Fail_Warn	UV Stream 2 - Stream Alarm Flow Sensor Fault
WRPM_CP204B_UV.General_Alarm	UV Stream 2 - Stream AlarmGeneral alarm trip
WRPM_CP204B_UV.General_Warn	UV Stream 2 - AlarmGeneral alarm warning
WRPM_CP204B_UV.Stream_Disable	UV Stream 2 - Stream AlarmGeneral Alarm
WRPM_CP204B_UV.Valve_Fail_Alarm	UV Stream 2 - Stream Alarm Valve Failure Trip
WRPM_CP204B_UV.Valve_Fail_Warn	UV Stream 2 - Stream Alarm Valve Failure Trip
WRPM_CP204B_UV26112.Cab_60_Warn	Cab 60 Warning
WRPM_CP204B_UV26112.Cab_70_Alarm	UV Stream 2 - Reactor 1 Cab 70 trip
WRPM_CP204B_UV26112.Current_Alarm	UV Sensor Current Alarm Trip
WRPM_CP204B_UV26112.Current_Warn	UV Sensor Current Alarm Warning
WRPM_CP204B_UV26112.Earth_Leak	Earth Leak Failure Trip
WRPM_CP204B_UV26112.General_Alarm	General UV Reactor Alarm Trip
WRPM_CP204B_UV26112.General_Warn	General UV Reactor Alarm Warning
WRPM_CP204B_UV26112.H2O_Sensor_Disc	Water Temperature Sensor Is Disconnected
WRPM_CP204B_UV26112.H2O_Temp_Alarm	Water Temperature Trip Alarm
WRPM_CP204B_UV26112.H2O_Temp_Warn	Water Temperature Warning Alarm
WRPM_CP204B_UV26112.Int_Fail_Alarm	UV Intensity Failure Alarm
WRPM_CP204B_UV26112.Int_Fail_Warn	UV Intensity Failure Warning Alarm
WRPM_CP204B_UV26112.Int_Low_Alarm	UV Intensity Low Trip Alarm
WRPM_CP204B_UV26112.Int_Low_Warn	UV Intensity Low Warning Alarm
WRPM_CP204B_UV26112.Lamp_Alarm	UV Lamp Alarm Trip
WRPM_CP204B_UV26112.Lamp_Run_Alarm	UV Lamp Run Trip Alarm
WRPM_CP204B_UV26112.Lamp_Run_Warn	UV Lamp Run Warning Alarm
WRPM_CP204B_UV26112.Lamp_Warn	UV Lamp Warning Alarm
WRPM_CP204B_UV26112.Lamps_Fail	All Lamps Have Failed
WRPM_CP204B_UV26112.VSA_Temp_Alarm	UV Stream 2 - Reactor 1 - VSA temp alarm
WRPM_CP204B_UV26112.VSA_Temp_Warn	VSA Temperature Warning Alarm
WRPM_CP204B_UV26112.Wiper_Alarm	Wiper In Trip
WRPM_CP204B_UV26112.Wiper_Warn	Wiper In Warning
WRPM_CP204B_UV26113.Cab_60_Warn	Cab 60 Warning
WRPM_CP204B_UV26113.Cab_70_Alarm	UV Stream 2 - Reactor 2 - Cab 70 trip
WRPM_CP204B_UV26113.Current_Alarm	UV Sensor Current Alarm Trip
WRPM_CP204B_UV26113.Current_Warn	UV Sensor Current Alarm Warning
WRPM_CP204B_UV26113.Earth_Leak	Earth Leak Failure Trip
WRPM_CP204B_UV26113.General_Alarm	General UV Reactor Alarm Trip
WRPM_CP204B_UV26113.General_Warn	General UV Reactor Alarm Warning
WRPM_CP204B_UV26113.H2O_Sensor_Disc	Water Temperature Sensor Is Disconnected
WRPM_CP204B_UV26113.H2O_Temp_Alarm	Water Temperature Trip Alarm
WRPM_CP204B_UV26113.H2O_Temp_Warn	Water Temperature Warning Alarm
WRPM_CP204B_UV26113.Int_Fail_Alarm	UV Intensity Failure Alarm
WRPM_CP204B_UV26113.Int_Fail_Warn	UV Intensity Failure Warning Alarm
WRPM_CP204B_UV26113.Int_Low_Alarm	UV Intensity Low Trip Alarm
WRPM_CP204B_UV26113.Int_Low_Warn	UV Intensity Low Warning Alarm
WRPM_CP204B_UV26113.Lamp_Alarm	UV Lamp Alarm Trip
WRPM_CP204B_UV26113.Lamp_Run_Alarm	UV Lamp Run Trip Alarm
WRPM_CP204B_UV26113.Lamp_Run_Warn	UV Lamp Run Warning Alarm
WRPM_CP204B_UV26113.Lamp_Warn	UV Lamp Warning Alarm
WRPM_CP204B_UV26113.Lamps_Fail	All Lamps Have Failed
WRPM_CP204B_UV26113.VSA_Temp_Alarm	UV Stream 2 - Reactor 2 -VSA temp alarm
WRPM_CP204B_UV26113.VSA_Temp_Warn	VSA Temperature Warning Alarm
WRPM_CP204B_UV26113.Wiper_Alarm	Wiper In Trip
WRPM_CP204B_UV26113.Wiper_Warn	Wiper In Warning
WRPM_CP263_Reuse_Skid.Fault	Reuse Water Pump System Fault
WRPM_CV26102_UV1_Valve.Close_Fault	UV1 Valve Failed to Close
WRPM_CV26102_UV1_Valve.Fault	Valve has Faulted
WRPM_CV26102_UV1_Valve.Open_Fault	UV1 Valve failed to Open
WRPM_CV26112_UV2_Valve.Close_Fault	UV2 Valve Failed to Close
WRPM_CV26112_UV2_Valve.Fault	Valve has Faulted

Tag Name	Alarm Description
WRPM_CV26112_UV2_Valve.Open_Fault	UV2 Valve failed to Open
WRPM_Fire_Zone1.Alarm_On	Headworks Zone 1 Fire Alarm
WRPM_Fire_Zone2.Alarm_On	Headworks Zone 2 Fire Alarm
WRPM_Fire_Zone3.Alarm_On	Operations Zone 3 Fire Alarm
WRPM_Fire_Zone4.Alarm_On	Operations Zone 4 Fire Alarm
WRPM_Fire_Zone5.Alarm_On	Operations Zone 5 Fire Alarm
WRPM_Fire_Zone6.Alarm_On	Operations Zone 6 Fire Alarm
WRPM_Fire_Zone7.Alarm_On	Operations Zone 7 Fire Alarm
WRPM_FSH_29001.Alarm_On	Operations Lab Eyewash & Shower Flow
WRPM_FSH_29002.Alarm_On	Operations Mechanical Room Eyewash & Shower
WRPM_FT20303_MBR_Influent.Xmitter_Fault	MBR Influent Flowmeter - Analog Transmitter Fault
WRPM_FT21311_Rec_to_Feed.Xmitter_Fault	Analog Transmitter Signal Quality Alarm
WRPM_FT21401_MLR_to_Solids.Xmitter_Fault	Analog Signal from Transmitter is outside Fault
WRPM_FT26310_Reuse_Water.Alarm_H	Reuse Water High Flow Alarm
WRPM_FT26310_Reuse_Water.Xmitter_Fault	Analog Signal from Transmitter is outside Fault
WRPM_FT26540_Inj_Flow.Xmitter_Fault	Injection Flowmeter - Analog Transmitter Signal
WRPM_FT27801_WAS_to_Truck.Xmitter_Fault	Analog Signal from Transmitter is outside Fault
WRPM_IW125_Comms_Fail.Alarm_On	Communications with CP-261 for lnjection Well
WRPM_IW36_Comms_Fail.Alarm_On	Communications with CP-262 for lnjection Well
WRPM_IW47_Comms_Fail.Alarm_On	Communications with CP-263 for lnjection Well
WRPM_LSH_26201_Reclaim_Tank.Alarm_On	Reuse Water Tank High level switch Alarm
WRPM_LSH_27805_Solids_Tank.Alarm_On	Solids Tank High level Switch Alarm
WRPM_LSH_29011_CLS_Day_Tank.Alarm_On	CLS Day Tank High level Switch Alarm
WRPM_LSL_26201_Reclaim_Tank.Alarm_On	Reuse Water Tank low Level Switch Alarm
WRPM_LSL_29011_CLS_Day_Tank.Alarm_On	CLS Day Tank low Level Switch Alarm
WRPM_LSLL_26201_Reclaim_Tank.Alarm_On	Reuse Water Tank low-low level Switch Alarm
WRPM_LSLL_27805_Solids_Tank.Alarm_On	Solids Tank low-low level Switch Alarm
WRPM_LSLL_29011_CLS_Day_Tank.Alarm_On	CLS Day Tank low-low Level Switch Alarm
WRPM_LT26200_Delta_Alarm.Alarm_On	Reuse Tank level Transmitters Delta Value Alarm
WRPM_LT26200_Reclaim_Tank.Alarm_H	Lag 1 Injection Well Start Reclaim Tank level
WRPM_LT26200_Reclaim_Tank.Alarm_HH	Reclaim Tank Level High-High Alarm
WRPM_LT26200_Reclaim_Tank.Alarm_L	Reclaim Tank Level below lnjector Pumps Alarm
WRPM_LT26200_Reclaim_Tank.Alarm_LL	Reclaim Tank Level low-low Alarm
WRPM_LT26200_Reclaim_Tank.Xmitter_Fault	DISABLED
WRPM_LT26202_Sig_Status.Alarm_On	Reuse Tank Level Transmitter LT26202 Signal Alarm
WRPM_LT26203_Sig_Status.Alarm_On	Reuse Tank Level Transmitter LT26203 Signal Alarm
WRPM_LT27803_Solids_Tank.Alarm_HH	Solids Tank Level High Alarm
WRPM_LT27803_Solids_Tank.Xmitter_Fault	Solids Tank Transmitter Fault
WRPM_LT29031_MgOH2_Tank.Alarm_L	MgOH2 Tank Level low Alarm
WRPM_LT29031_MgOH2_Tank.Alarm_LL	MgOH2 Tank Level low-low Alarm
WRPM_LT29031_MgOH2_Tank.Xmitter_Fault	Analog Signal from Transmitter is outside Fault
WRPM_MBR_Comms_Fault.Alarm_On	Communications with MBR Failed
WRPM_P26114_UVBYPASS.CntlPwr	DISABLED
WRPM_P26114_UVBYPASS.Fault	UV Bypass Pump - General Fault
WRPM_P26114_UVBYPASS.HMI_Auto	UV Bypass Pump - HMI In Auto
WRPM_P26114_UVBYPASS.OL	UV Bypass Pump - Motor Over load
WRPM_P26114_UVBYPASS.Remote_Out	UV Bypass Pump - Pump not available for Remote
WRPM_P26114_UVBYPASS.Start_Fault	Motor Failed to Start
WRPM_P26531_Inj_P1.Fault	Injection Pump #1 - General Fault
WRPM_P26531_Inj_P1.HMI_Auto	Injection Pump #1 - NOT in HMI Auto
WRPM_P26531_Inj_P1.Remote_Out	Injection Pump #1 - VFD not available for Remote
WRPM_P26531_Inj_P1.Start_Fault	Injection Pump #1 - Motor Failed to Start
WRPM_P26531_Inj_P1.VFDFault	Injection Pump #1 - VFD Fault
WRPM_P26532_Inj_P2.Fault	Injection Pump #2 - General Fault
WRPM_P26532_Inj_P2.HMI_Auto	Injection Pump #2 - NOT In HM! Auto
WRPM_P26532_Inj_P2.Remote_Out	Injection Pump #2 - VFD not available for Remote
WRPM_P26532_Inj_P2.Start_Fault	Injection Pump #2 - Motor Failed to Start
WRPM_P26532_Inj_P2.VFDFault	Injection Pump #2 - VFD Fault
WRPM_P26533_Inj_P3.Fault	Injection Pump #3 - General Fault
WRPM_P26533_Inj_P3.HMI_Auto	Injection Pump #3 - NOT In HM! Auto
WRPM_P26533_Inj_P3.Remote_Out	Injection Pump #3 - VFD not available for Remote
WRPM_P26533_Inj_P3.Start_Fault	Injection Pump #3 - Motor Failed to Start
WRPM_P26533_Inj_P3.VFDFault	Injection Pump #3 - VFD Fault

Tag Name	Alarm Description
WRPM_P26534_Inj_P4.Fault	Injection Pump #4 - General Fault
WRPM_P26534_Inj_P4.HMI_Auto	Injection Pump #4 - NOT In HM! Auto
WRPM_P26534_Inj_P4.Remote_Out	Injection Pump #4 - VFD not available for Remote
WRPM_P26534_Inj_P4.Start_Fault	Injection Pump #4 - Motor Failed to Start
WRPM_P26534_Inj_P4.VFDFault	Injection Pump #4 - VFD Fault
WRPM_P27801_WAS_Fd_P1.CntlPwr	WAS Feed Pump #1 - NO Control Power
WRPM_P27801_WAS_Fd_P1.Fault	WAS Feed Pump #1 - General Fault
WRPM_P27801_WAS_Fd_P1.HMI_Auto	WAS Feed Pump #1 - NOT in HMI Auto
WRPM_P27801_WAS_Fd_P1.Remote_Out	WAS Feed Pump #1 - Pump not available for Remote
WRPM_P27801_WAS_Fd_P1.Start_Fault	WAS Feed Pump #1 - Motor Failed to Start
WRPM_P27802_WAS_Fd_P2.CntlPwr	WAS Feed Pump #2 - NO Control Power
WRPM_P27802_WAS_Fd_P2.Fault	WAS Feed Pump #2 - General Fault
WRPM_P27802_WAS_Fd_P2.HMI_Auto	WAS Feed Pump #2 - NOT in HMI Auto
WRPM_P27802_WAS_Fd_P2.Remote_Out	WAS Feed Pump #2 - Pump not available for Remote
WRPM_P27802_WAS_Fd_P2.Start_Fault	WAS Feed Pump #2 - Motor Failed to Start
WRPM_P27807_WAS_Ld_P2.CntlPwr	WAS Load Pump #2 - NO Control Power
WRPM_P27807_WAS_Ld_P2.Fault	WAS Load Pump #2 - General Fault
WRPM_P27807_WAS_Ld_P2.HMI_Auto	WAS Load Pump #2 - NOT in HMI Auto
WRPM_P27807_WAS_Ld_P2.OvrTemp	WAS Load Pump #2 - Motor Over Temp
WRPM_P27807_WAS_Ld_P2.Remote_Out	WAS Load Pump #2 - Pump not available for Remote
WRPM_P27807_WAS_Ld_P2.Seal_Fail	WAS Load Pump #2 - Pump Seal Failure
WRPM_P27807_WAS_Ld_P2.Start_Fault	WAS Load Pump #2 - Motor Failed to Start
WRPM_P29021_CLS_P1.Fault	CL2 Pump #1 - Fault
WRPM_P29021_CLS_P1.HMI_Auto	CL2 Pump #1 - NOT In HMI Auto
WRPM_P29021_CLS_P1.Start_Fault	CL2 Pump #1 - Motor Failed to Start
WRPM_P29022_CLS_P2.Fault	CL2 Pump #2 - Fault
WRPM_P29022_CLS_P2.HMI_Auto	CL2 Pump #2 - NOT In HMI Auto
WRPM_P29022_CLS_P2.Start_Fault	CL2 Pump #2 - Motor Failed to Start
WRPM_P29023_CLS_P3.Fault	CL2 Pump #3 - Fault
WRPM_P29023_CLS_P3.HMI_Auto	CL2 Pump #3 - NOT In HMI Auto
WRPM_P29023_CLS_P3.Start_Fault	CL2 Pump #3 - Motor Failed to Start
WRPM_P29041_MgOH2_P1.Fault	MgOH2 Pump #1 - Fault
WRPM_P29041_MgOH2_P1.HMI_Auto	MgOH2 Pump #1 - NOT In HMI Auto
WRPM_P29041_MgOH2_P1.Start_Fault	MgOH2 Pump #1 - Motor Failed to Start
WRPM_P29042_MgOH2_P2.Fault	MgOH2 Pump #2 - Fault
WRPM_P29042_MgOH2_P2.HMI_Auto	MgOH2 Pump #2 - NOT In HMI Auto
WRPM_P29042_MgOH2_P2.Start_Fault	MgOH2 Pump #2 - Motor Failed to Start
WRPM_PT26310_Reuse_Header.Xmitter_Fault	Analog Signal from Transmitter is outside Fault
WRPM_PT26530_Inj_PSI.Xmitter_Fault	Analog Signal from Transmitter is outside Fault
WRPM_TSH_27804_Blower_Air.Alarm_On	Blower Air Temp High
WRPM_UV2_Comms_Fault.Alarm_On	Communications with UV2 Failed
WRPM_XA_28000_Grind_Sump_Flt.Alarm_On	Operations Grinder Pump Wet Well Level High
WRPM_ZS20100A_Ops_Elec_Dr.Alarm_On	Operations Electrical Room Door Intrusion Alarm
WRPM_ZS20100B_Ops_Mech_Dr.Alarm_On	Operations Mechanical Room Door Intrusion Alarm
WRPM_ZS20100C_Ops_Mech_Dr.Alarm_On	Operations Mechanical Room Door Intrusion Alarm
WRPM_ZS20100D_Ops_Elec_Dr.Alarm_On	Operations Electrical Room Door Intrusion Alarm
WRPM_ZS20301A_MBR_Utilidor.Alarm_On	Operations Mechanical Door Intrusion Alarm
WRPM_ZS20301C_Ops_Front_Dr.Alarm_On	Operations Front Door Intrusion Alarm
WRPM_ZS20301D_Mez_Dr.Alarm_On	Mezzanine Door Intrusion Alarm is Active
WRPM_ZS26201_Reclaim_Tank_Hatch.Alarm_On	Reuse Water Tank Hatch Intruder Alarm

Appendix D

SCADA Screens

APPENDIX D

SCADA Screens

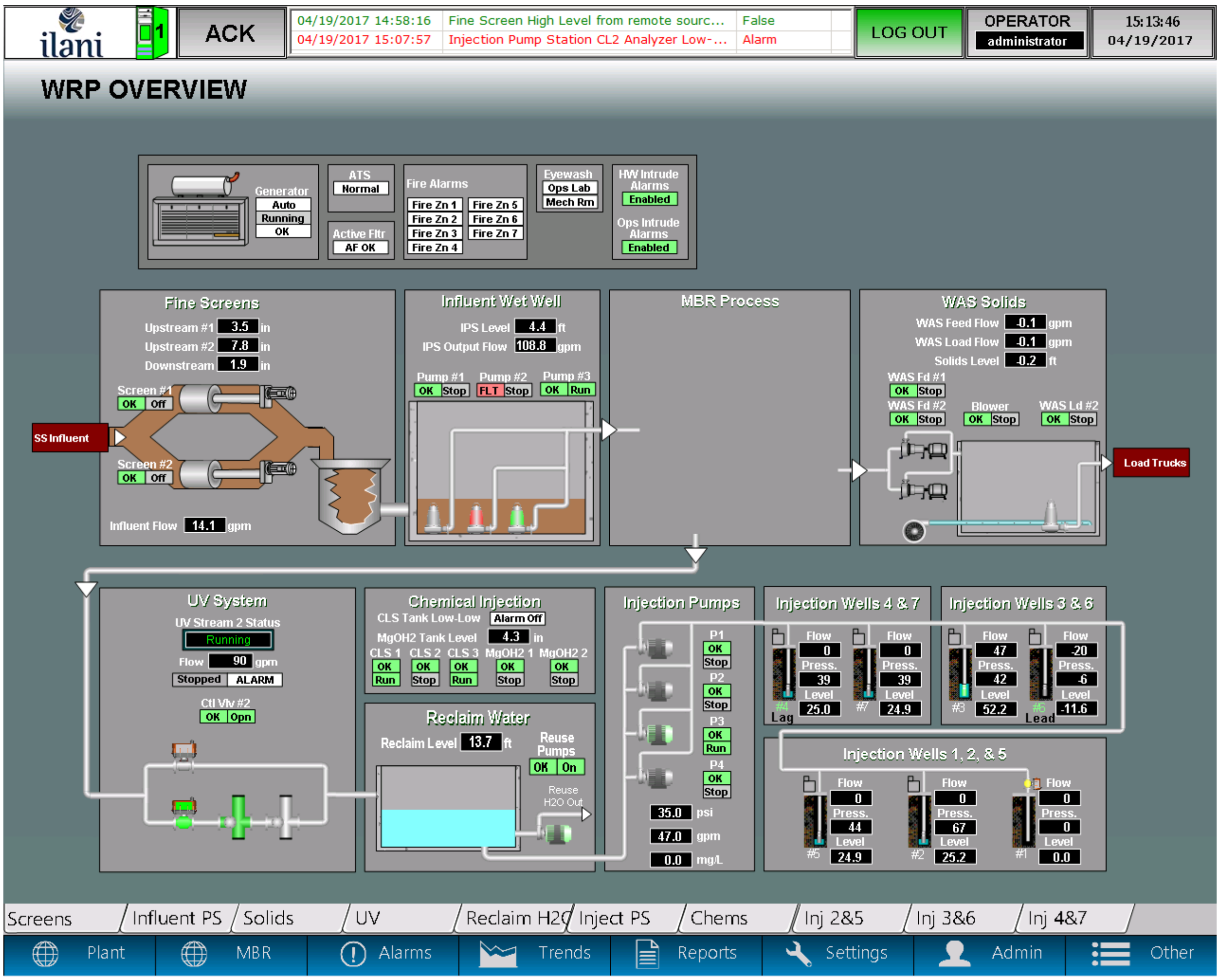


Figure D-1. SCADA Overview Screen

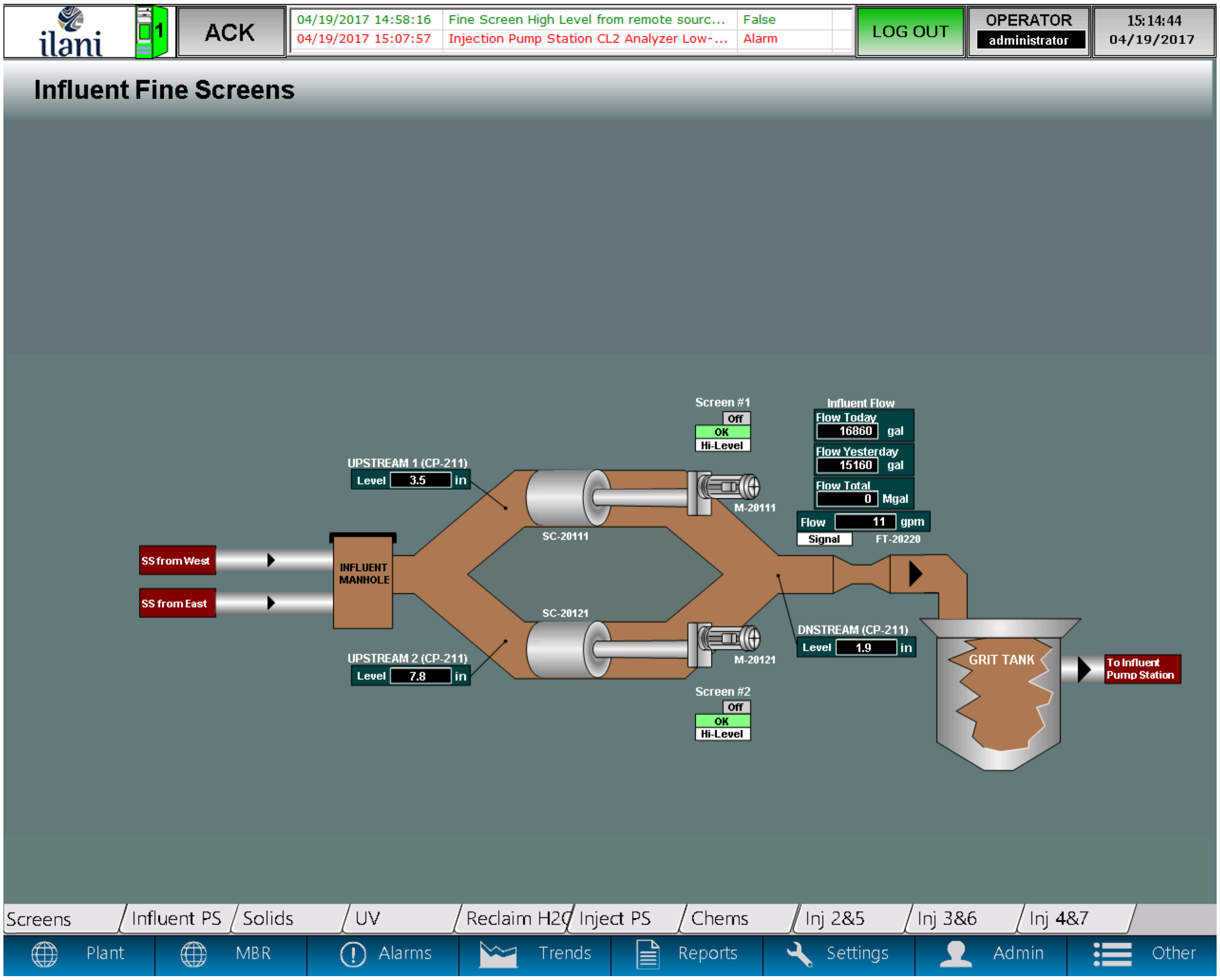


Figure D-2. Influent Fine Screens

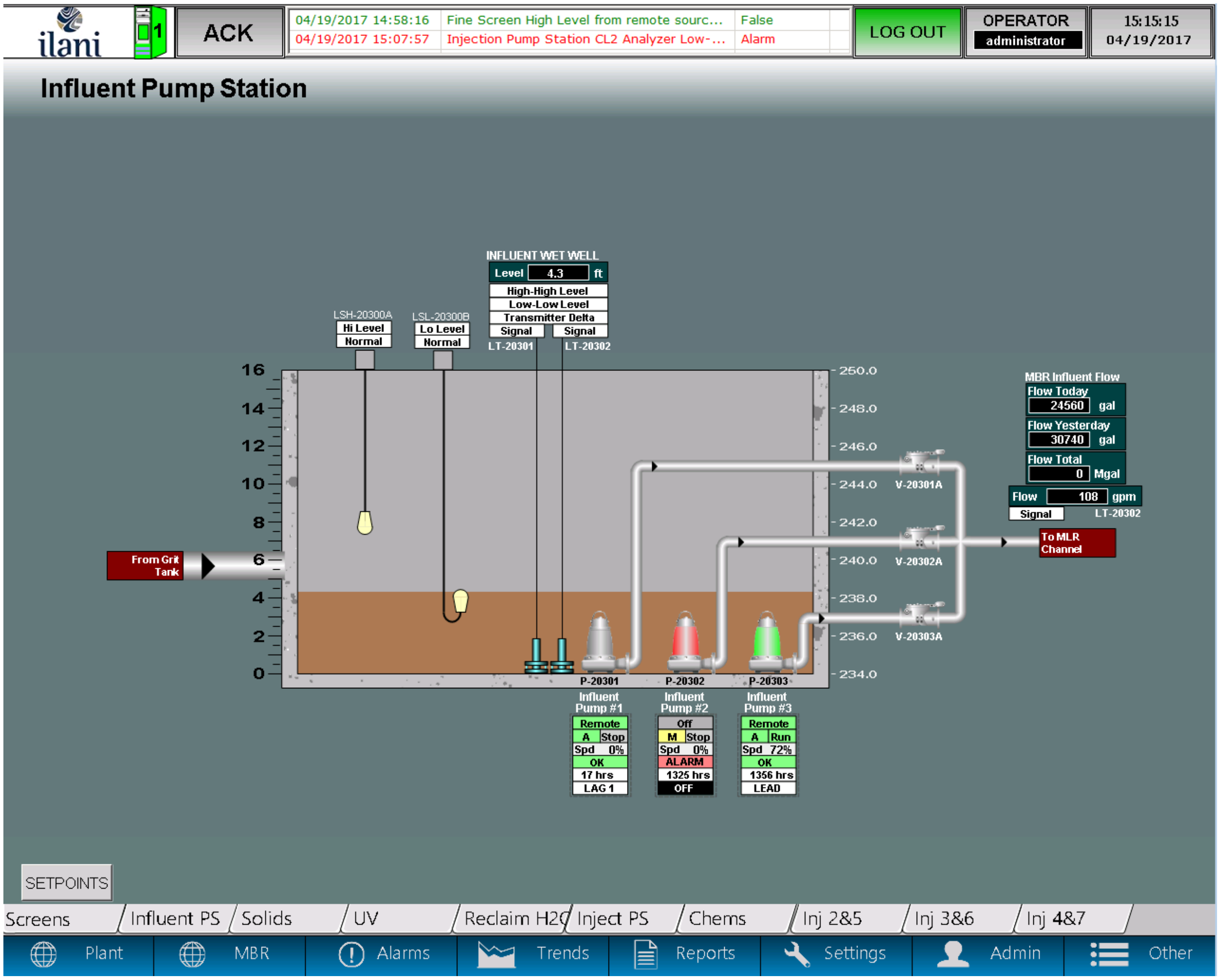


Figure D-3. Influent Pump Station

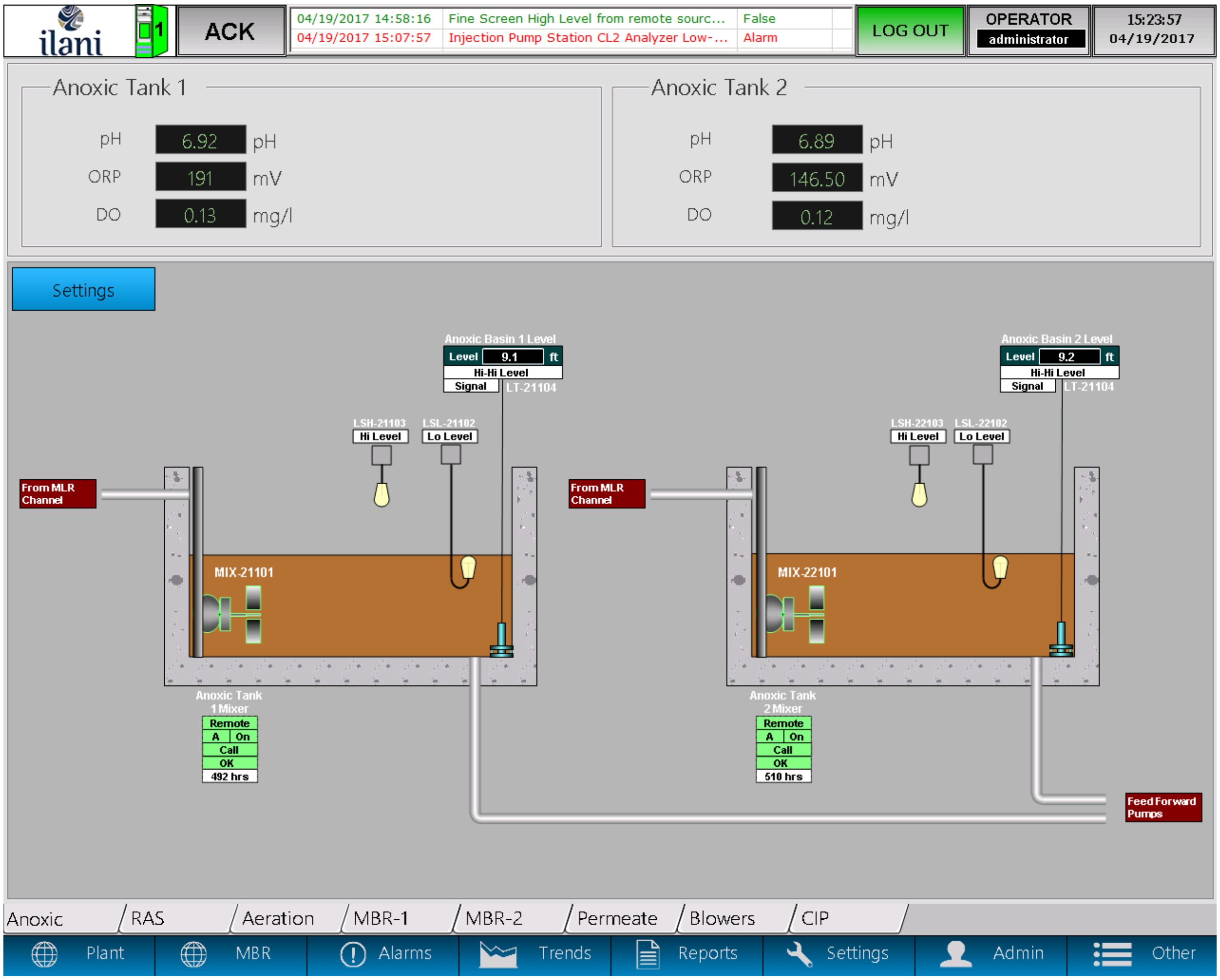


Figure D-4. MBR Anoxic Tanks

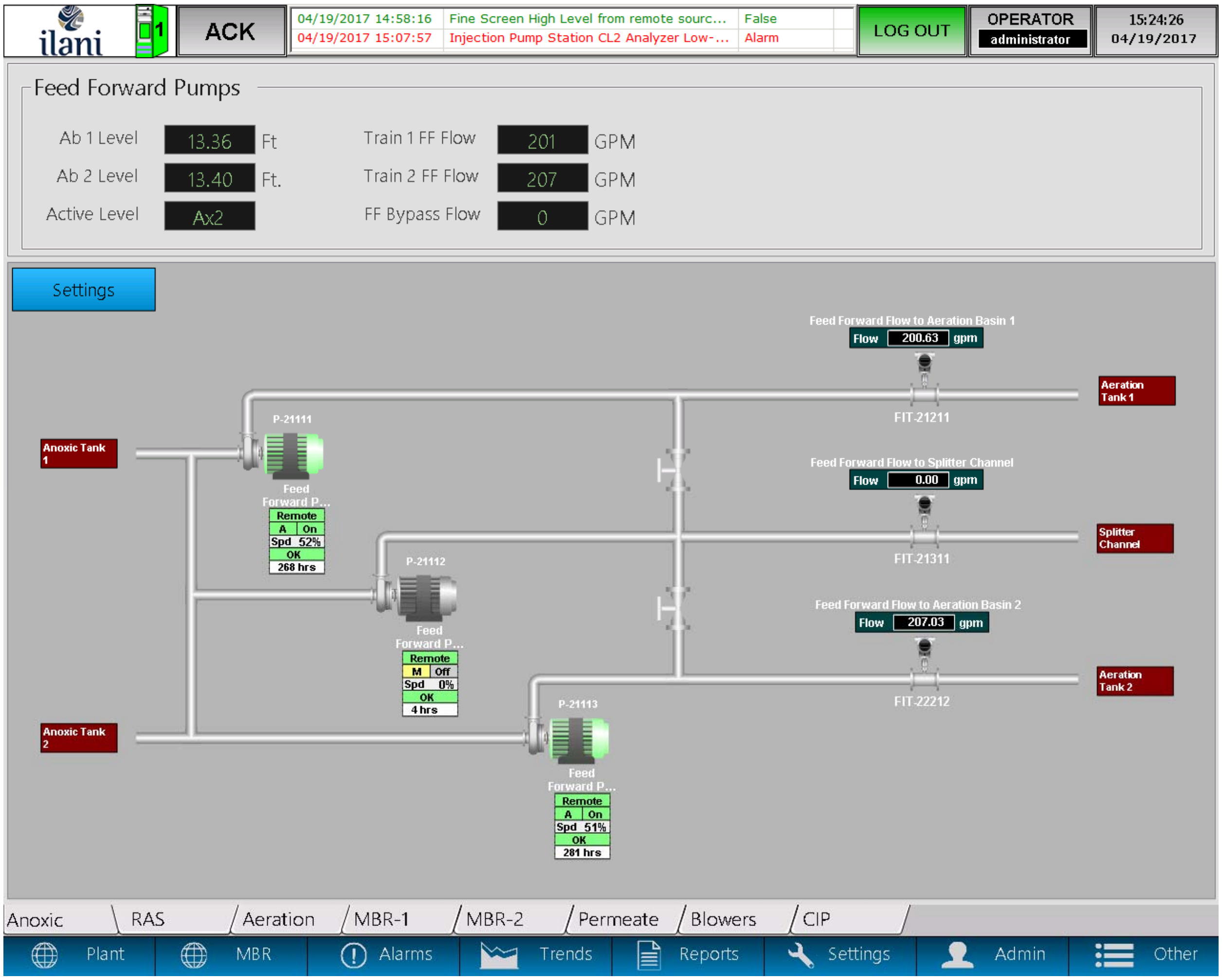


Figure D-5. Feed Forward Pumps

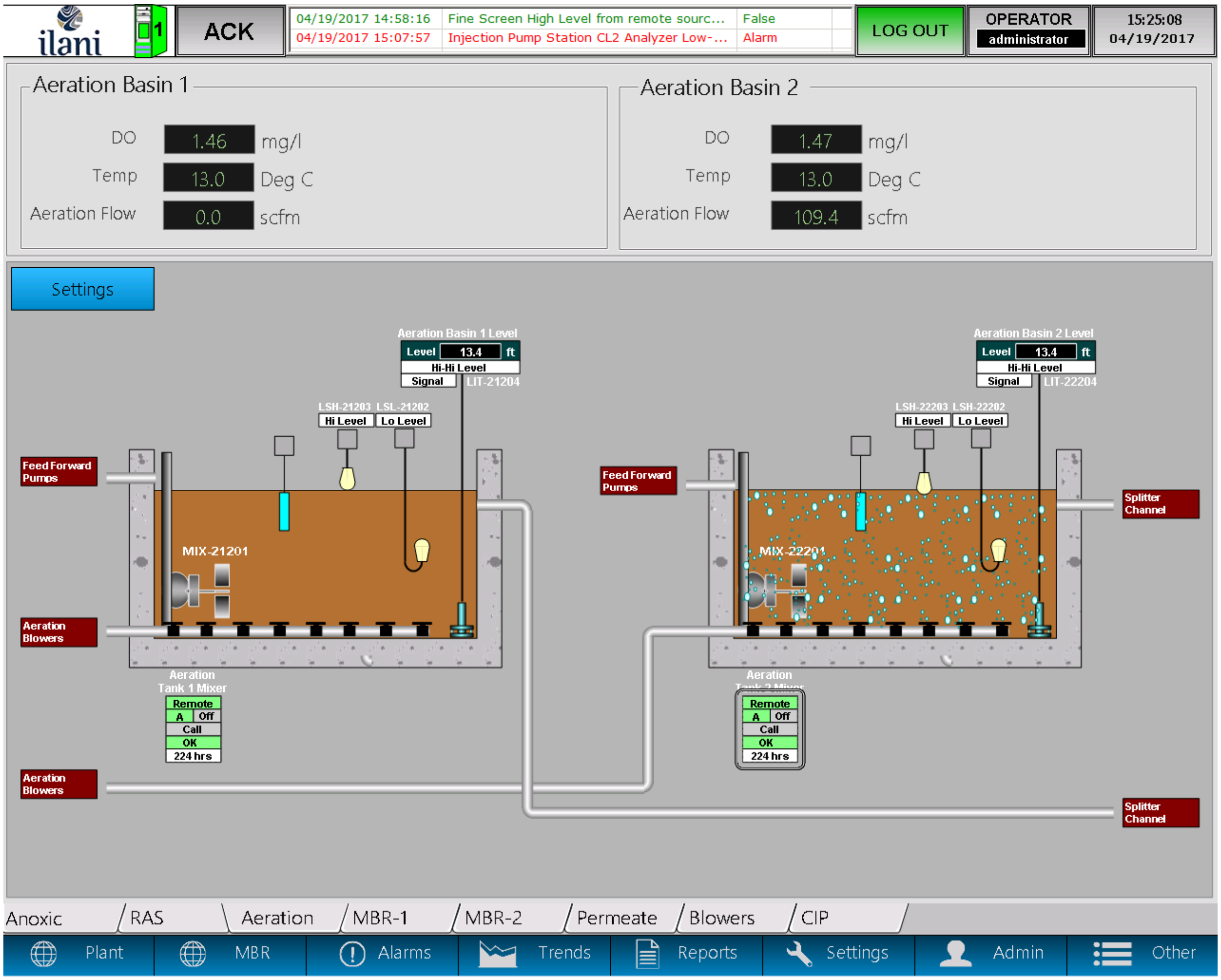


Figure D-6. Aeration Basins

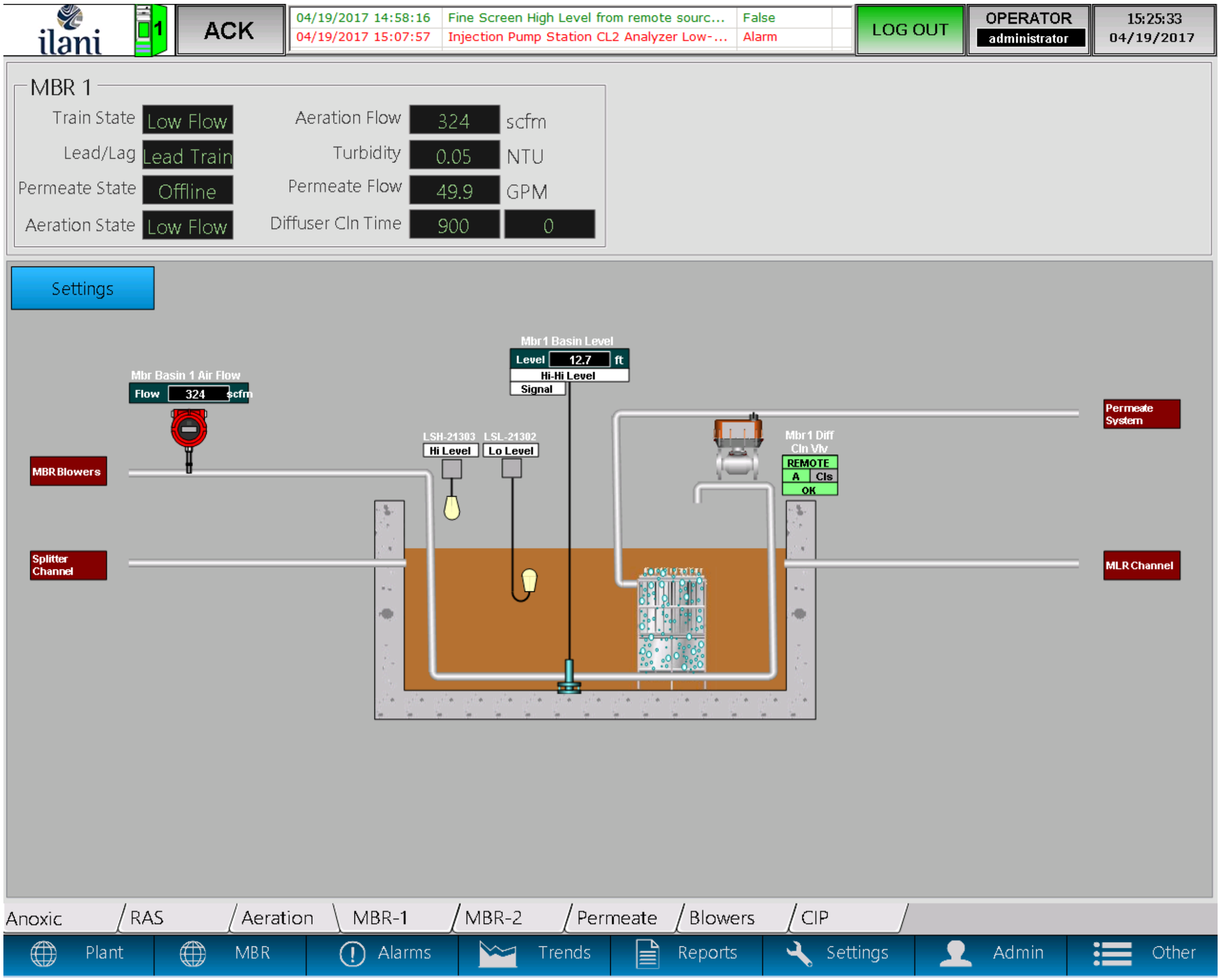


Figure D-7. MBR 1

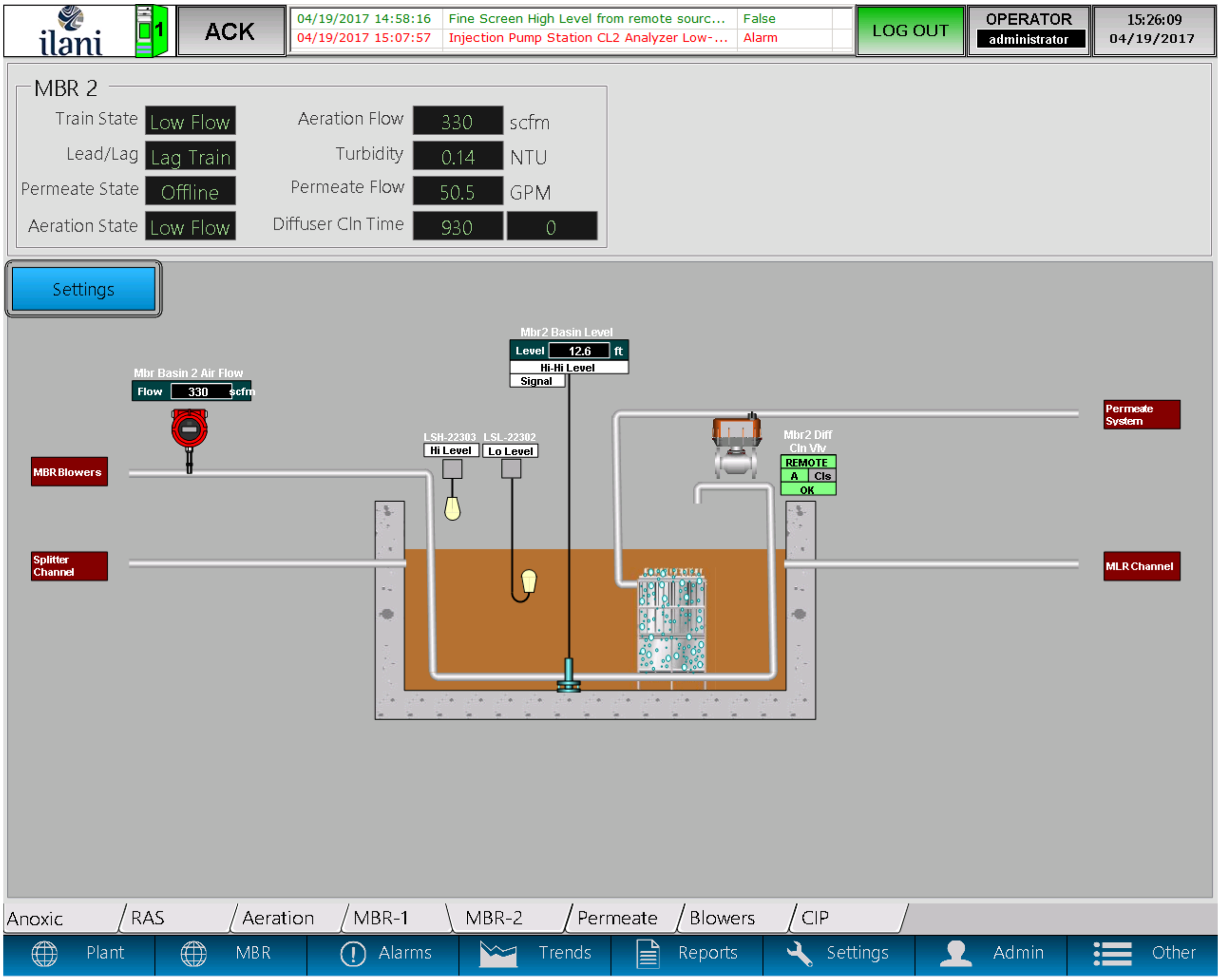


Figure D-8. MBR 2

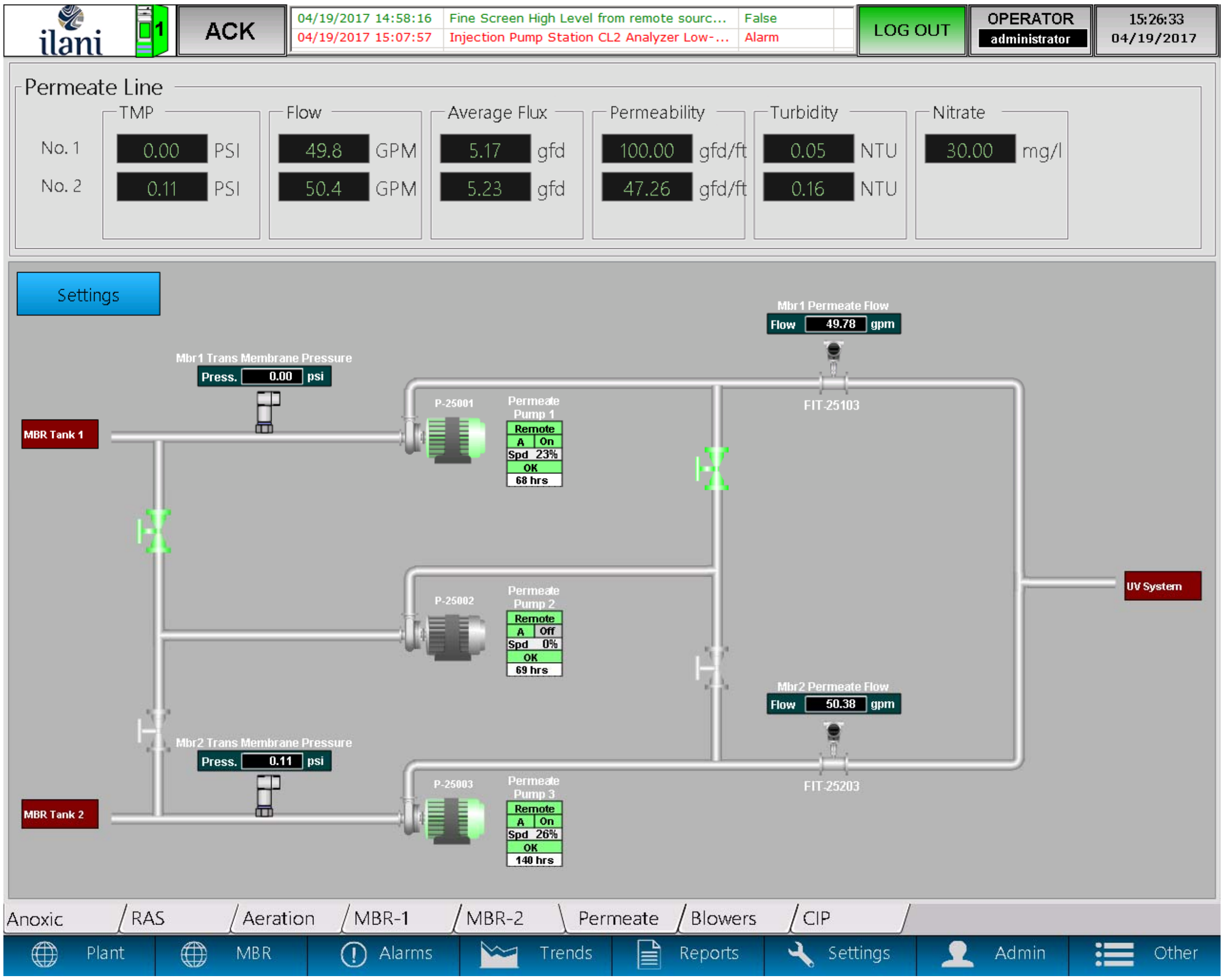


Figure D-9. Permeate System

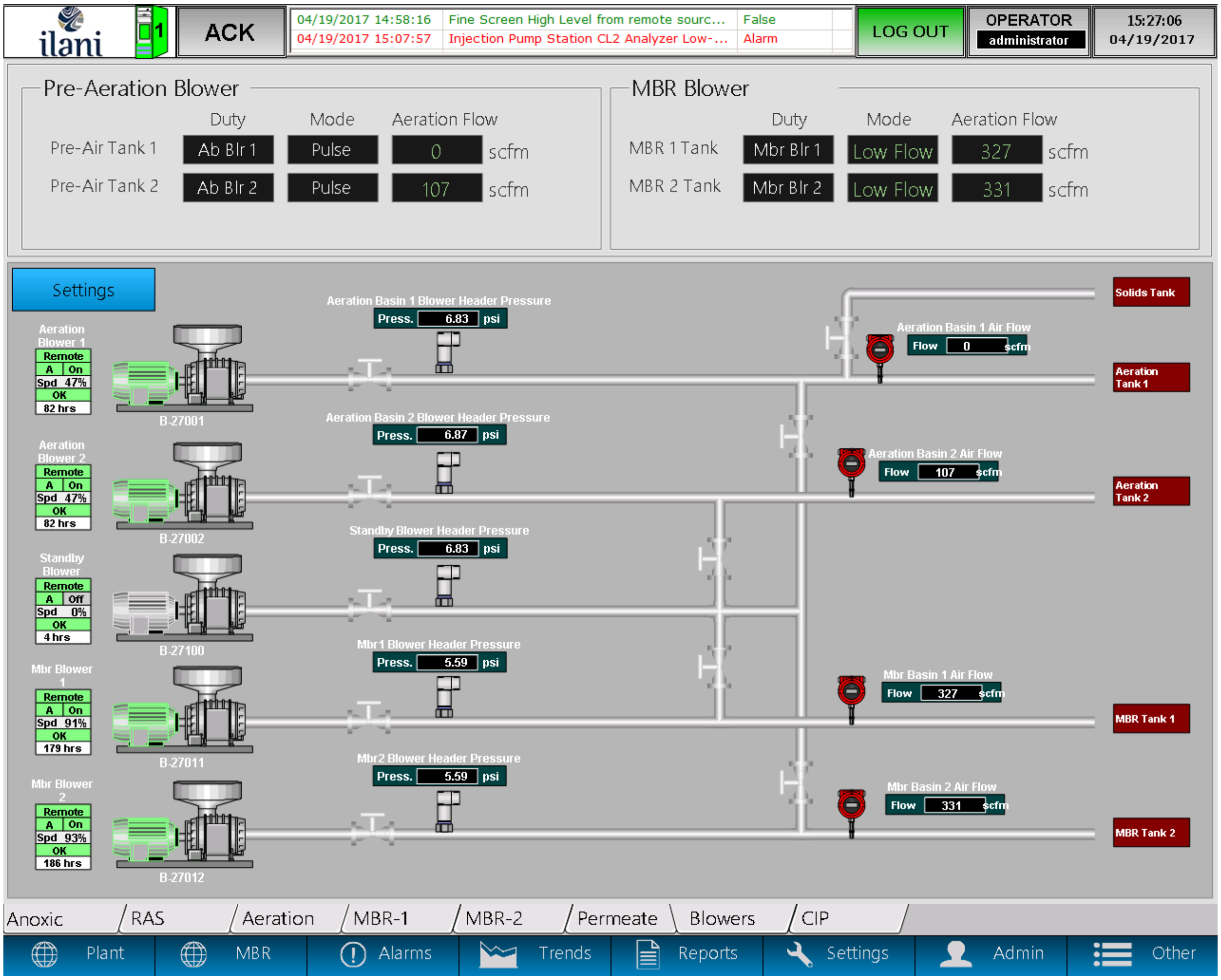


Figure D-10. Blowers Screen

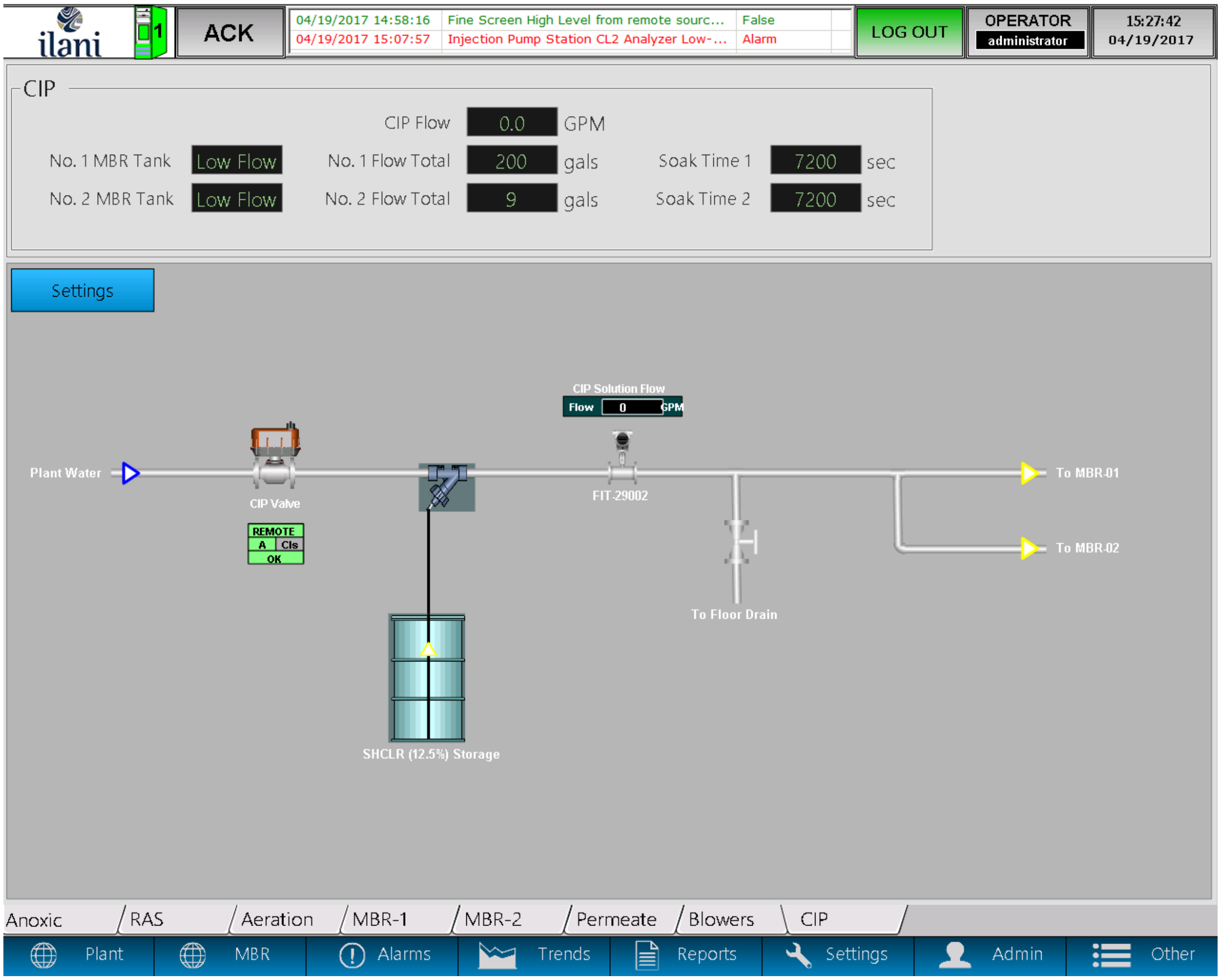


Figure D-11. Chemical Injection Process – Screen 1

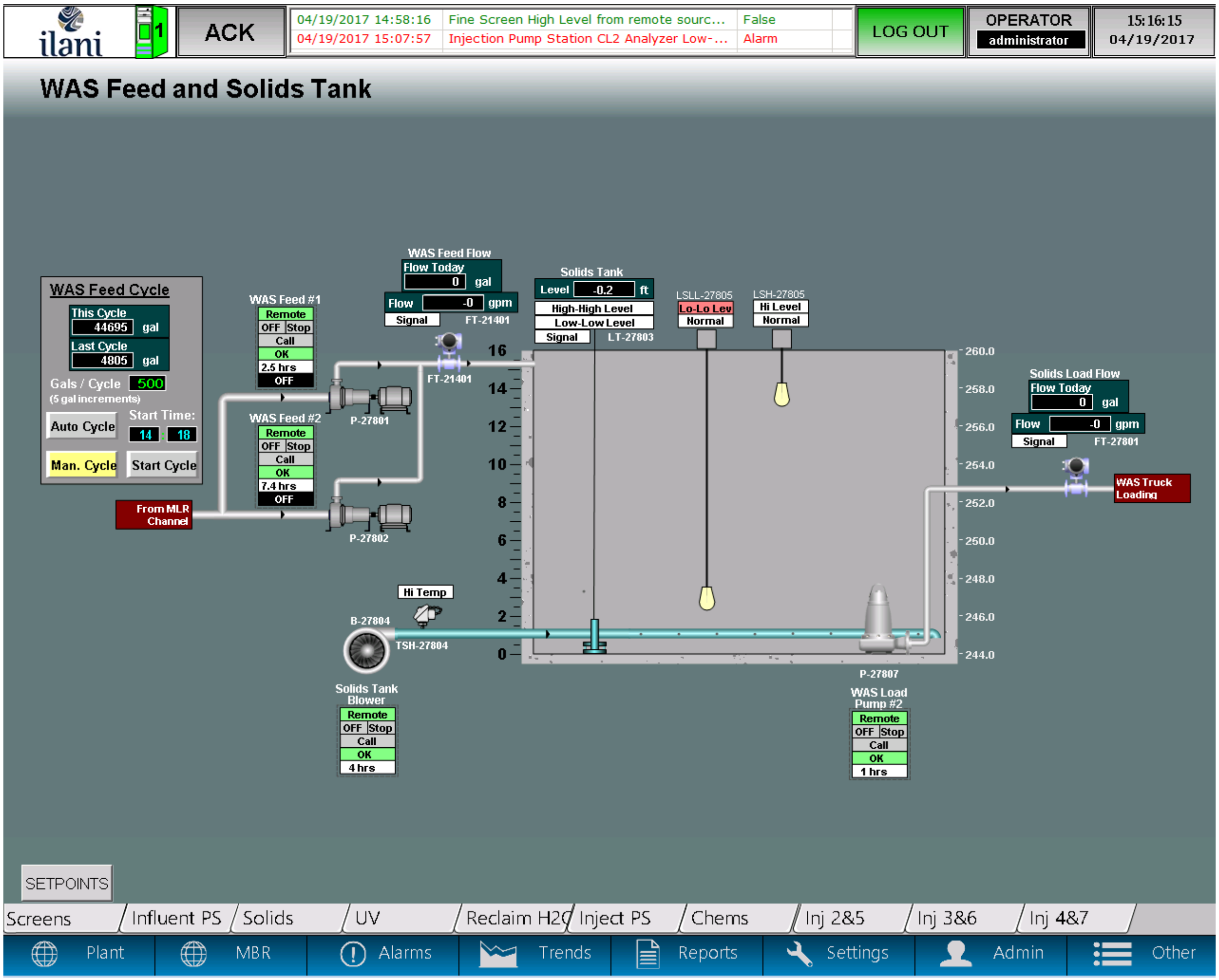


Figure D-12. WAS Feed and Solids Tank

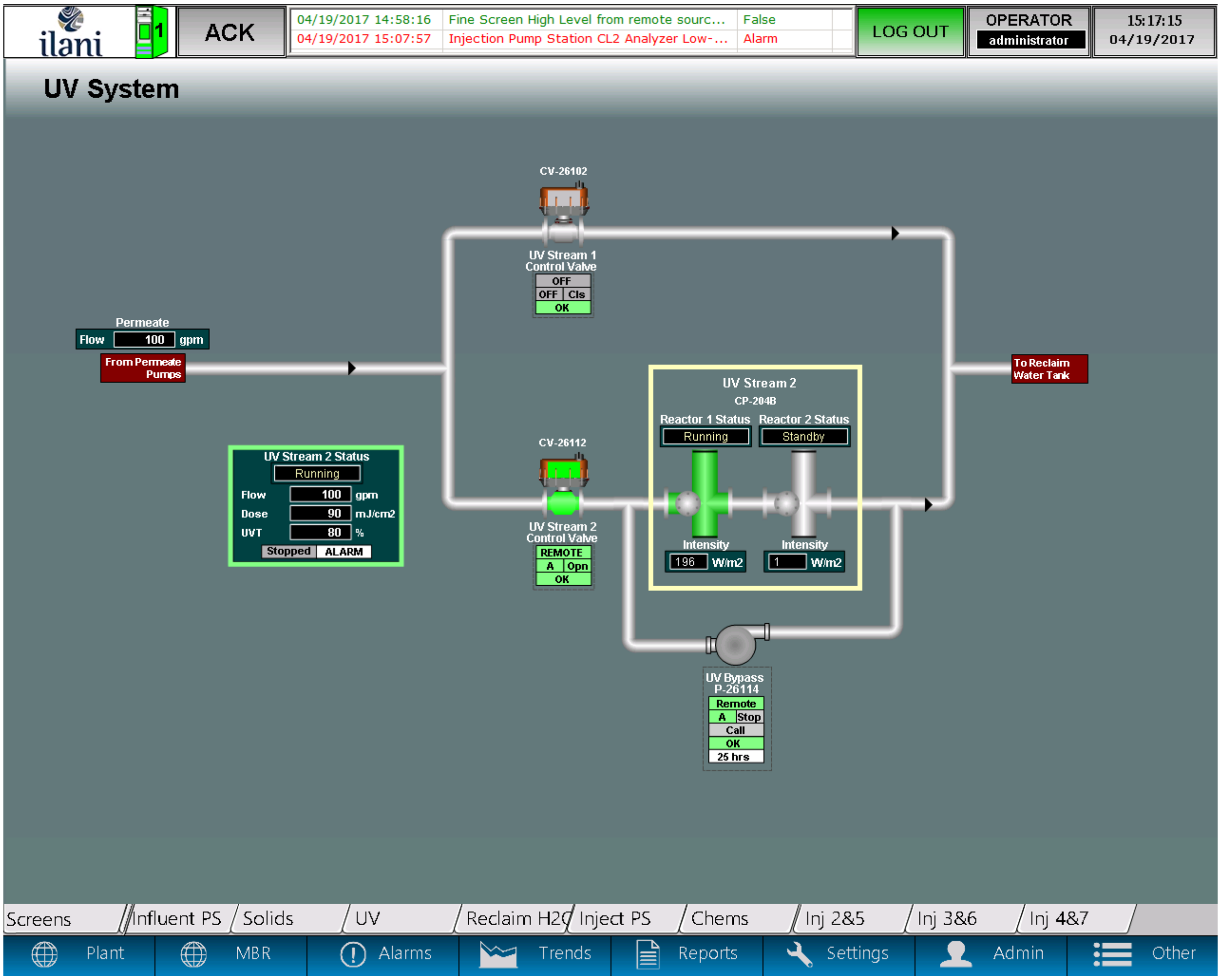


Figure D-13. UV System

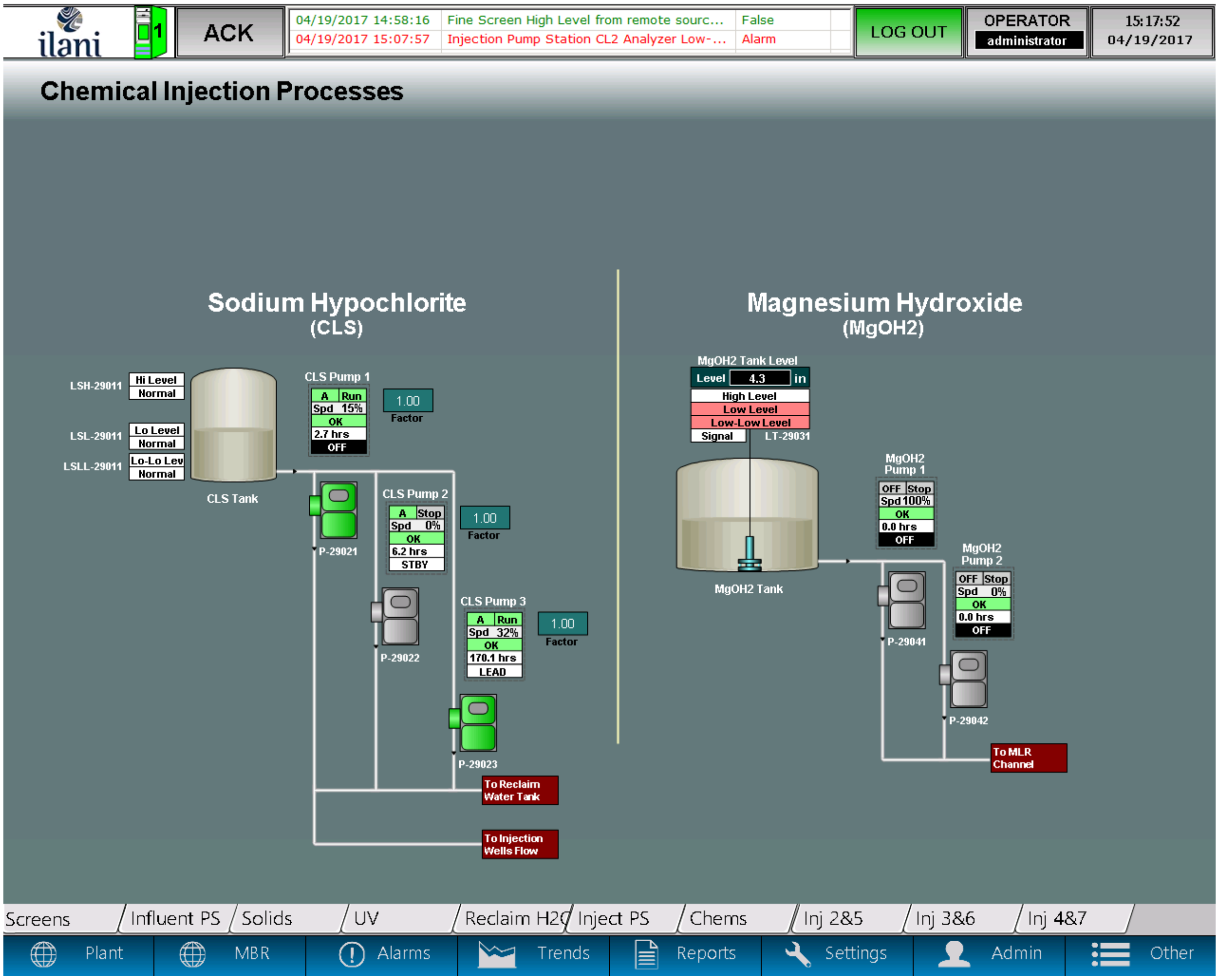


Figure D-14. Chemical Injection Process – Screen 2

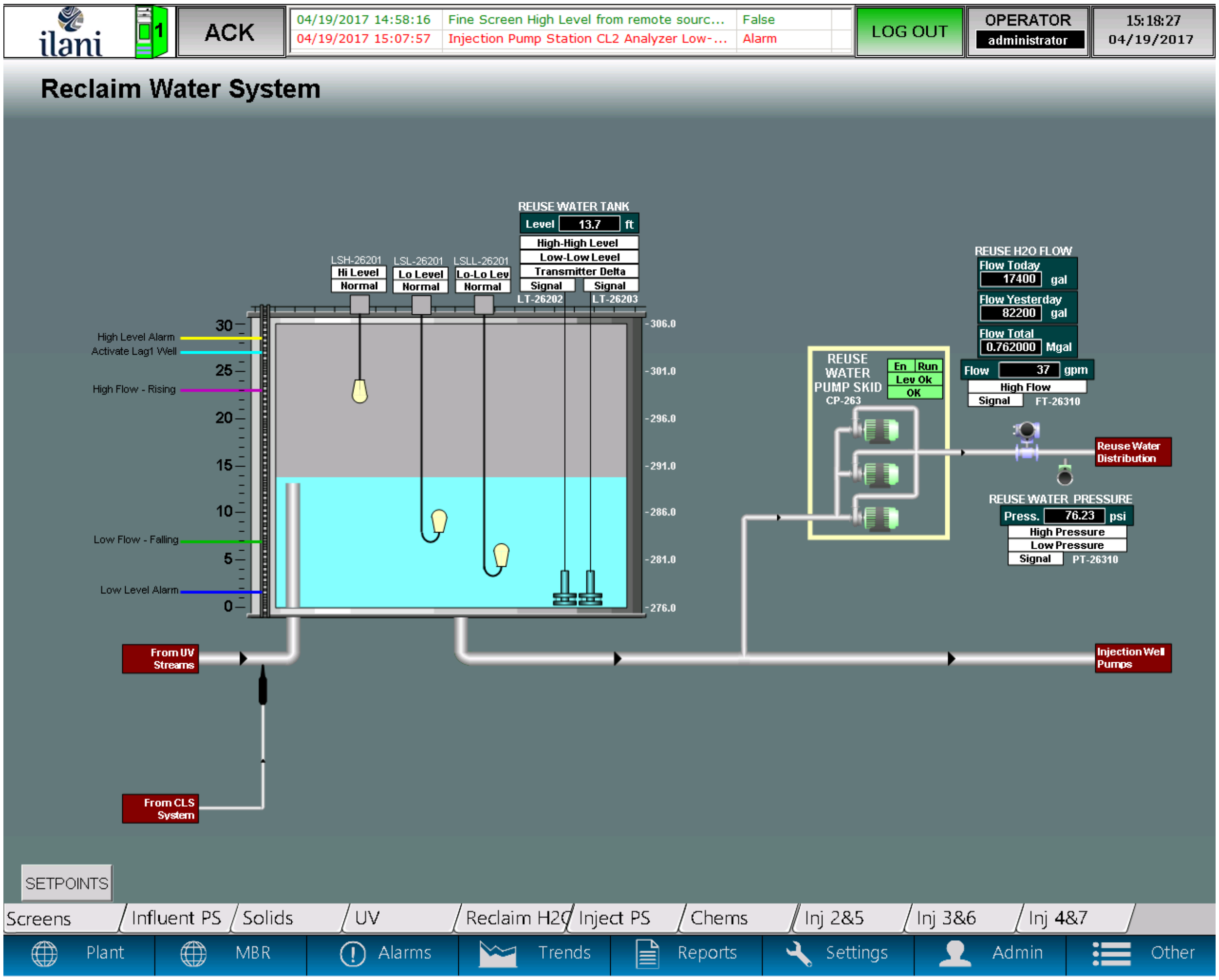


Figure D-15. Reclaimed Water System

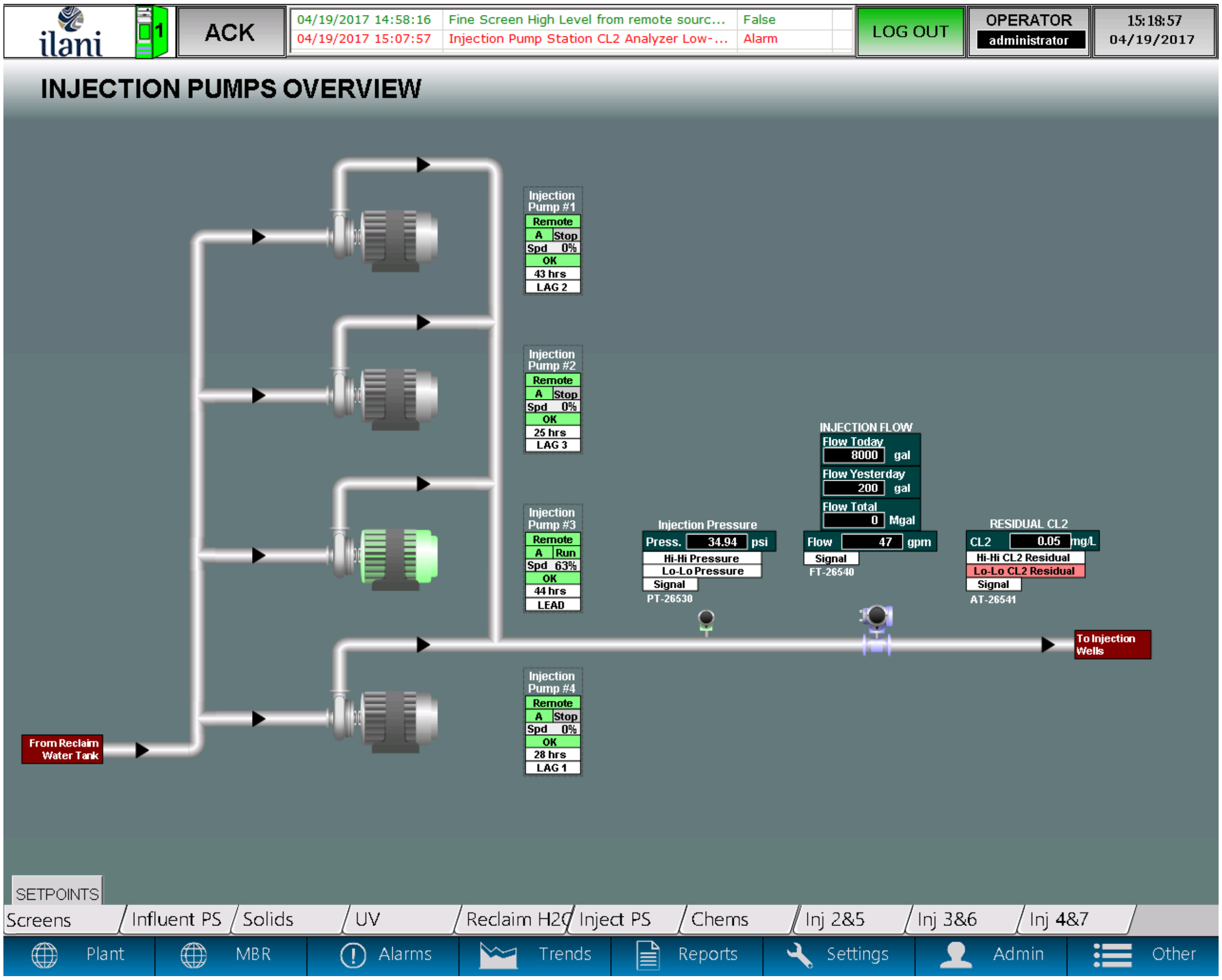


Figure D-16. Injection Pump Overview

Figure D-17. Injection Wells 4 and 7

Figure D-18. Injection Wells 3 and 6

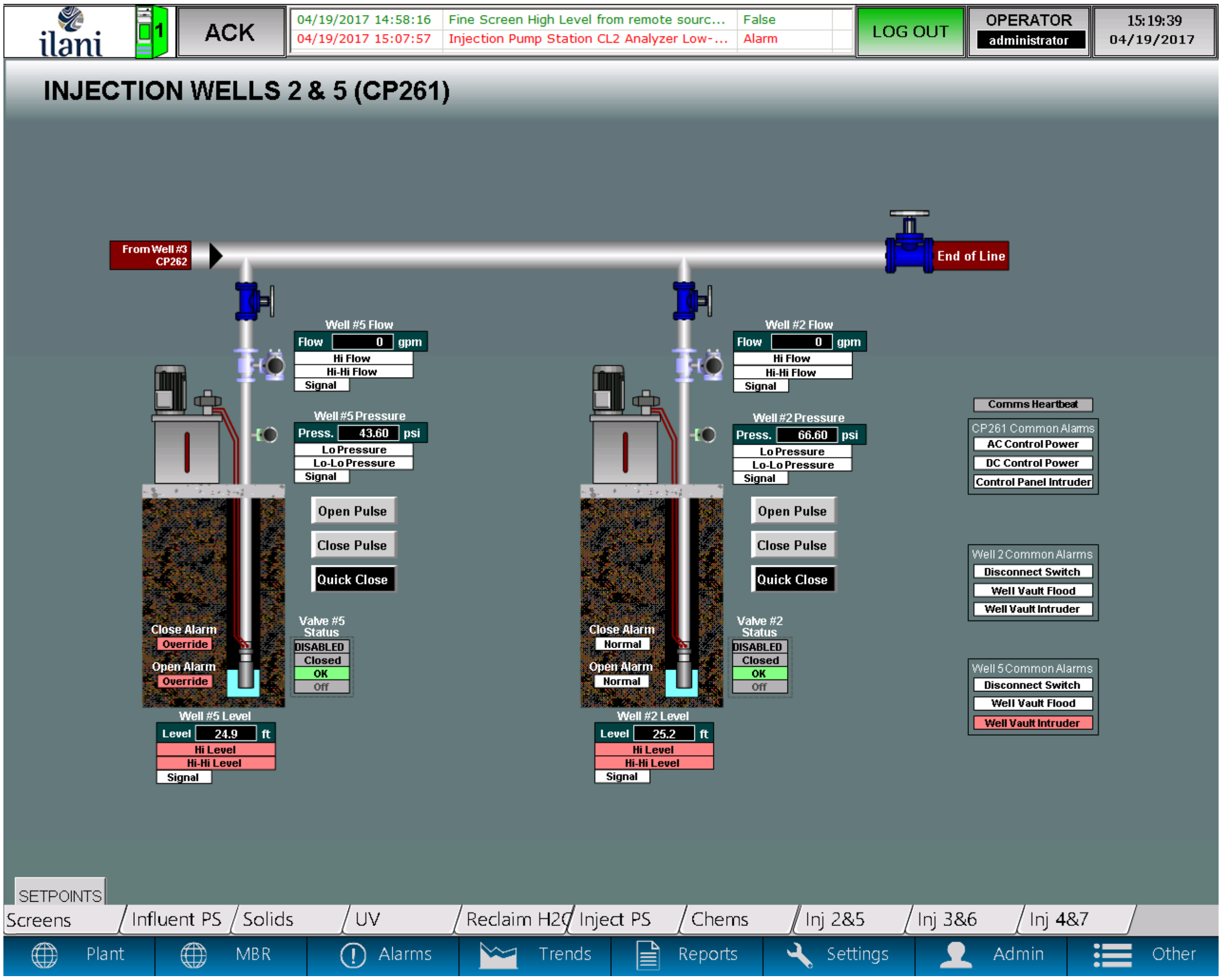
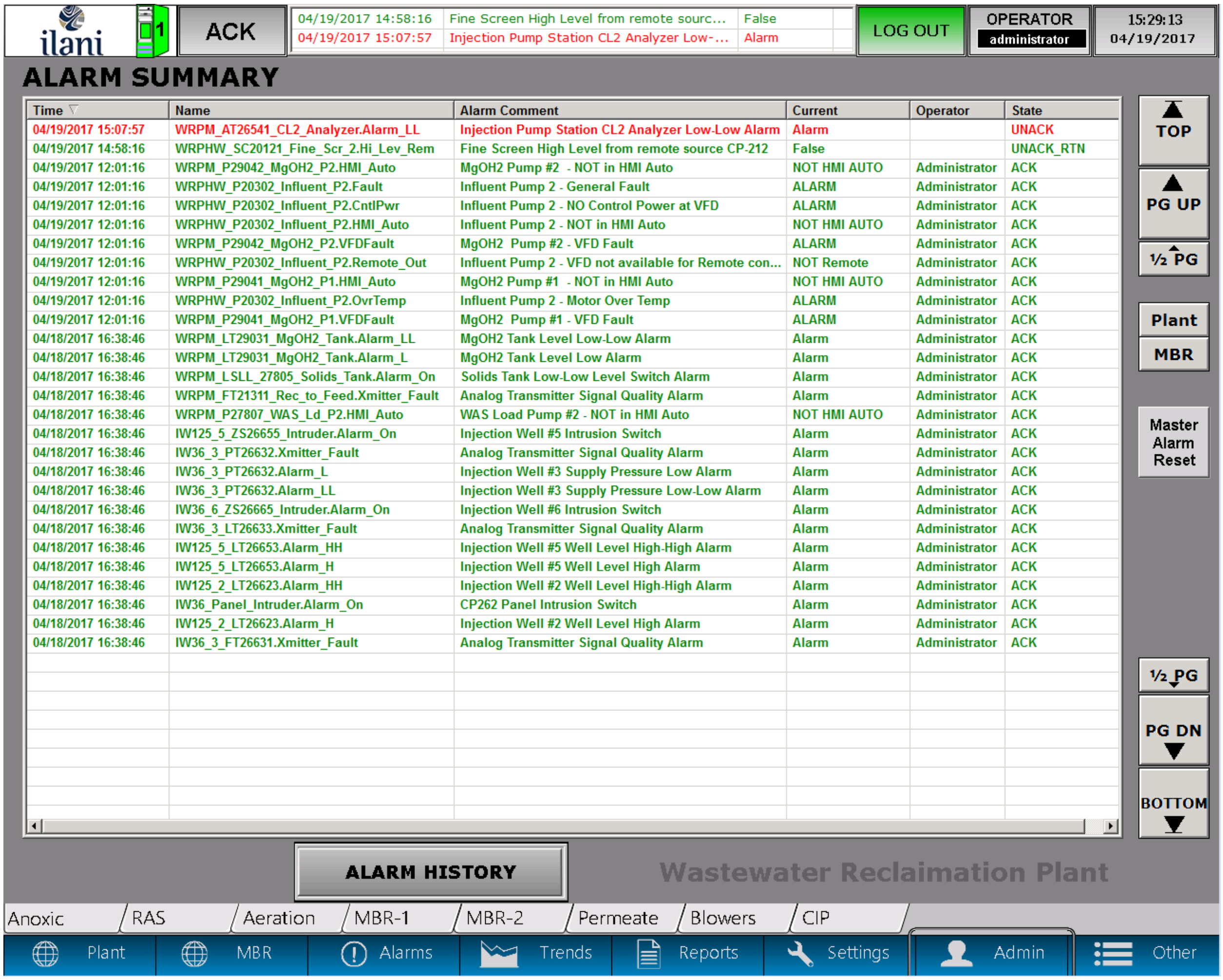


Figure D-19. Injection Wells 2 and 5



Time	Name	Alarm Comment	Current	Operator	State
04/19/2017 15:07:57	WRPM_AT26541_CL2_Analyzer.Alarm_LL	Injection Pump Station CL2 Analyzer Low-Low Alarm	Alarm		UNACK
04/19/2017 14:58:16	WRPHW_SC20121_Fine_Scr_2.Hi_Lev_Rem	Fine Screen High Level from remote source CP-212	False		UNACK_RTN
04/19/2017 12:01:16	WRPM_P29042_MgOH2_P2.HMI_Auto	MgOH2 Pump #2 - NOT in HMI Auto	NOT HMI AUTO	Administrator	ACK
04/19/2017 12:01:16	WRPHW_P20302_Influent_P2.Fault	Influent Pump 2 - General Fault	ALARM	Administrator	ACK
04/19/2017 12:01:16	WRPHW_P20302_Influent_P2.CntlPwr	Influent Pump 2 - NO Control Power at VFD	ALARM	Administrator	ACK
04/19/2017 12:01:16	WRPHW_P20302_Influent_P2.HMI_Auto	Influent Pump 2 - NOT in HMI Auto	NOT HMI AUTO	Administrator	ACK
04/19/2017 12:01:16	WRPM_P29042_MgOH2_P2.VFDFault	MgOH2 Pump #2 - VFD Fault	ALARM	Administrator	ACK
04/19/2017 12:01:16	WRPHW_P20302_Influent_P2.Remote_Out	Influent Pump 2 - VFD not available for Remote con...	NOT Remote	Administrator	ACK
04/19/2017 12:01:16	WRPM_P29041_MgOH2_P1.HMI_Auto	MgOH2 Pump #1 - NOT in HMI Auto	NOT HMI AUTO	Administrator	ACK
04/19/2017 12:01:16	WRPHW_P20302_Influent_P2.OvrTemp	Influent Pump 2 - Motor Over Temp	ALARM	Administrator	ACK
04/19/2017 12:01:16	WRPM_P29041_MgOH2_P1.VFDFault	MgOH2 Pump #1 - VFD Fault	ALARM	Administrator	ACK
04/18/2017 16:38:46	WRPM_LT29031_MgOH2_Tank.Alarm_LL	MgOH2 Tank Level Low-Low Alarm	Alarm	Administrator	ACK
04/18/2017 16:38:46	WRPM_LT29031_MgOH2_Tank.Alarm_L	MgOH2 Tank Level Low Alarm	Alarm	Administrator	ACK
04/18/2017 16:38:46	WRPM_LSLL_27805_Solids_Tank.Alarm_On	Solids Tank Low-Low Level Switch Alarm	Alarm	Administrator	ACK
04/18/2017 16:38:46	WRPM_FT21311_Rec_to_Feed.Xmitter_Fault	Analog Transmitter Signal Quality Alarm	Alarm	Administrator	ACK
04/18/2017 16:38:46	WRPM_P27807_WAS_Ld_P2.HMI_Auto	WAS Load Pump #2 - NOT in HMI Auto	NOT HMI AUTO	Administrator	ACK
04/18/2017 16:38:46	IW125_5_ZS26655_Intruder.Alarm_On	Injection Well #5 Intrusion Switch	Alarm	Administrator	ACK
04/18/2017 16:38:46	IW36_3_PT26632.Xmitter_Fault	Analog Transmitter Signal Quality Alarm	Alarm	Administrator	ACK
04/18/2017 16:38:46	IW36_3_PT26632.Alarm_L	Injection Well #3 Supply Pressure Low Alarm	Alarm	Administrator	ACK
04/18/2017 16:38:46	IW36_3_PT26632.Alarm_LL	Injection Well #3 Supply Pressure Low-Low Alarm	Alarm	Administrator	ACK
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04/18/2017 16:38:46	IW125_2_LT26623.Alarm_HH	Injection Well #2 Well Level High-High Alarm	Alarm	Administrator	ACK
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Figure D-20. Alarm Summary

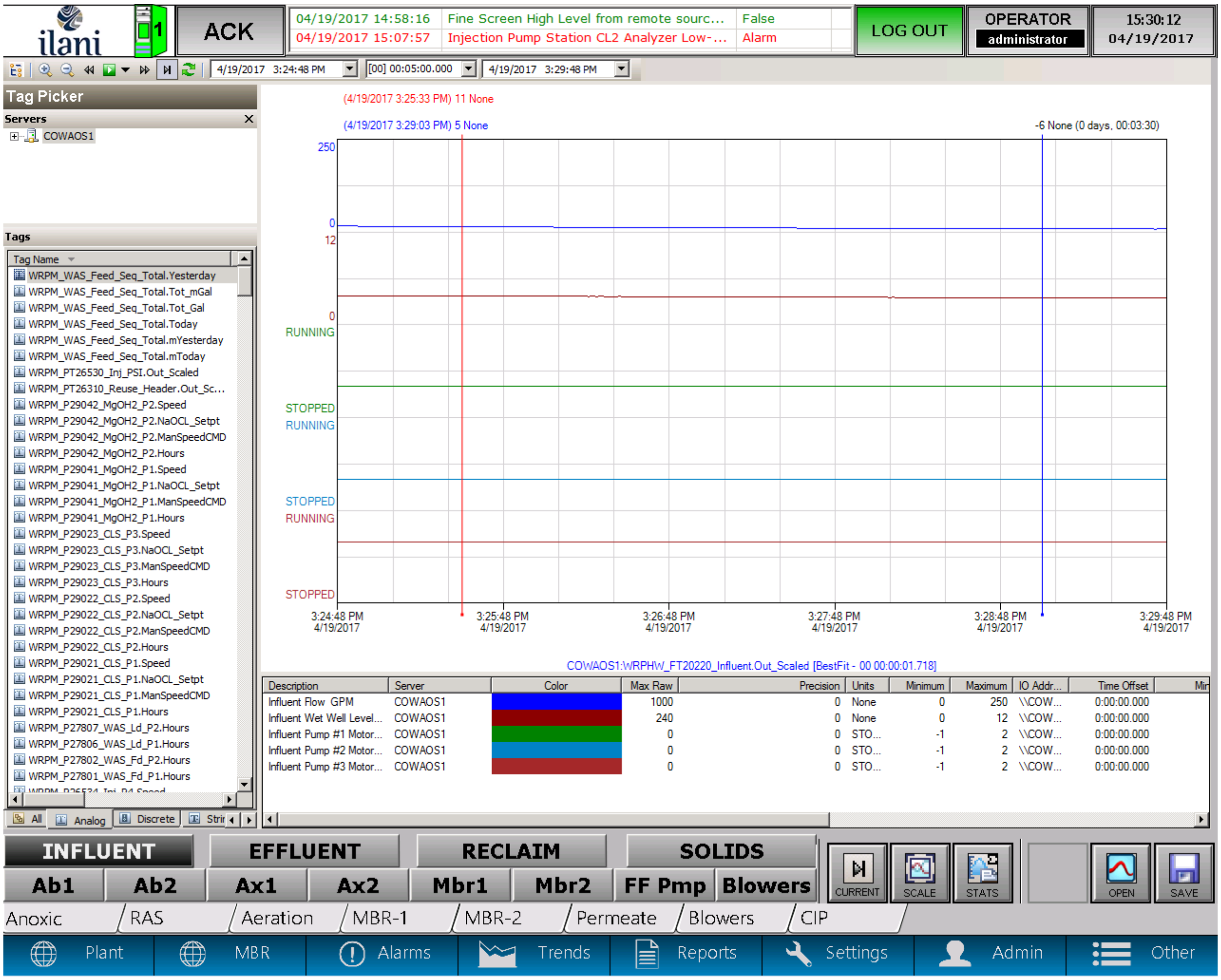

Figure D-21. Influent Trend Screen

Figure D-22. Effluent Trend Screen

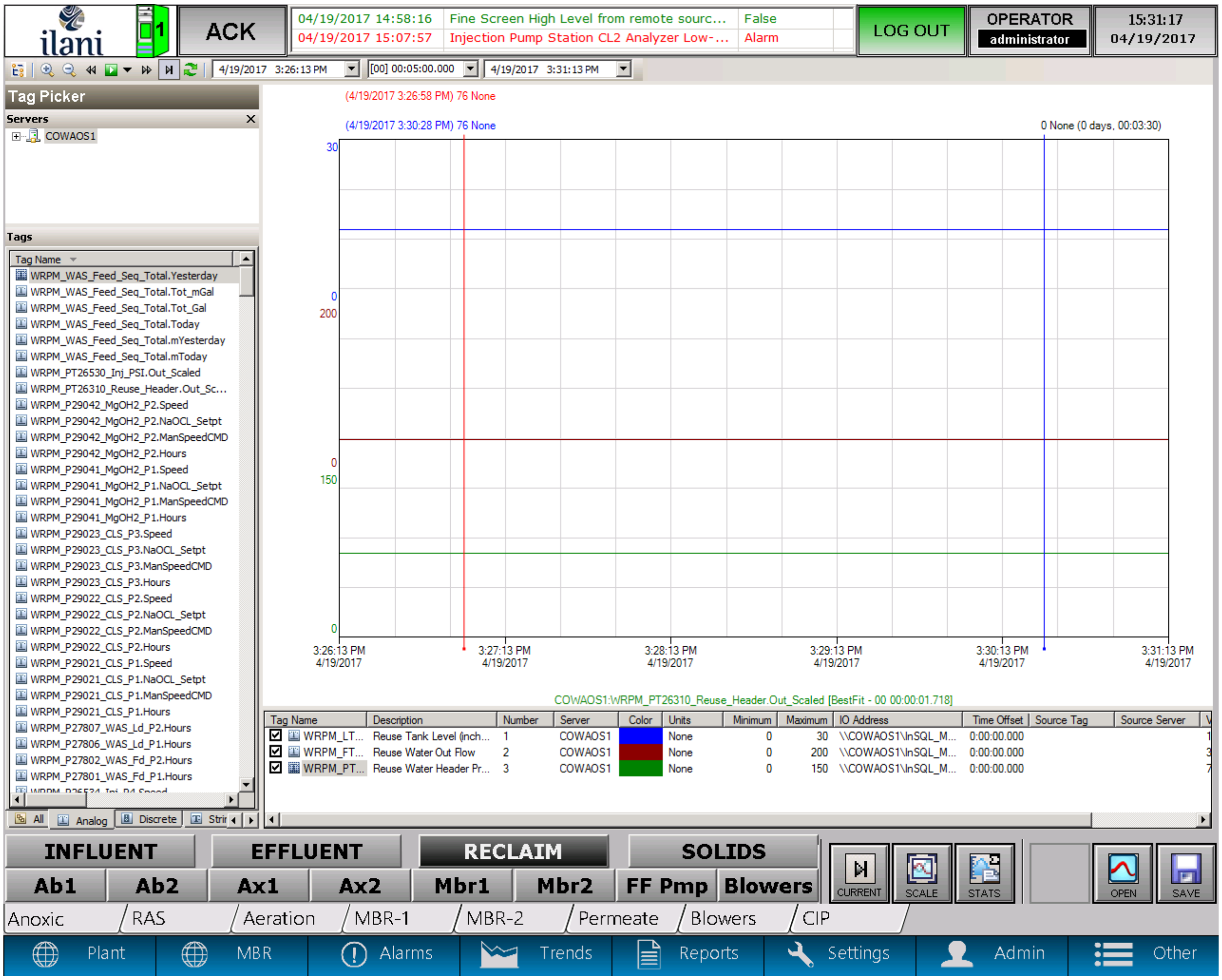

Figure D-23. Reclaim Trend Screen

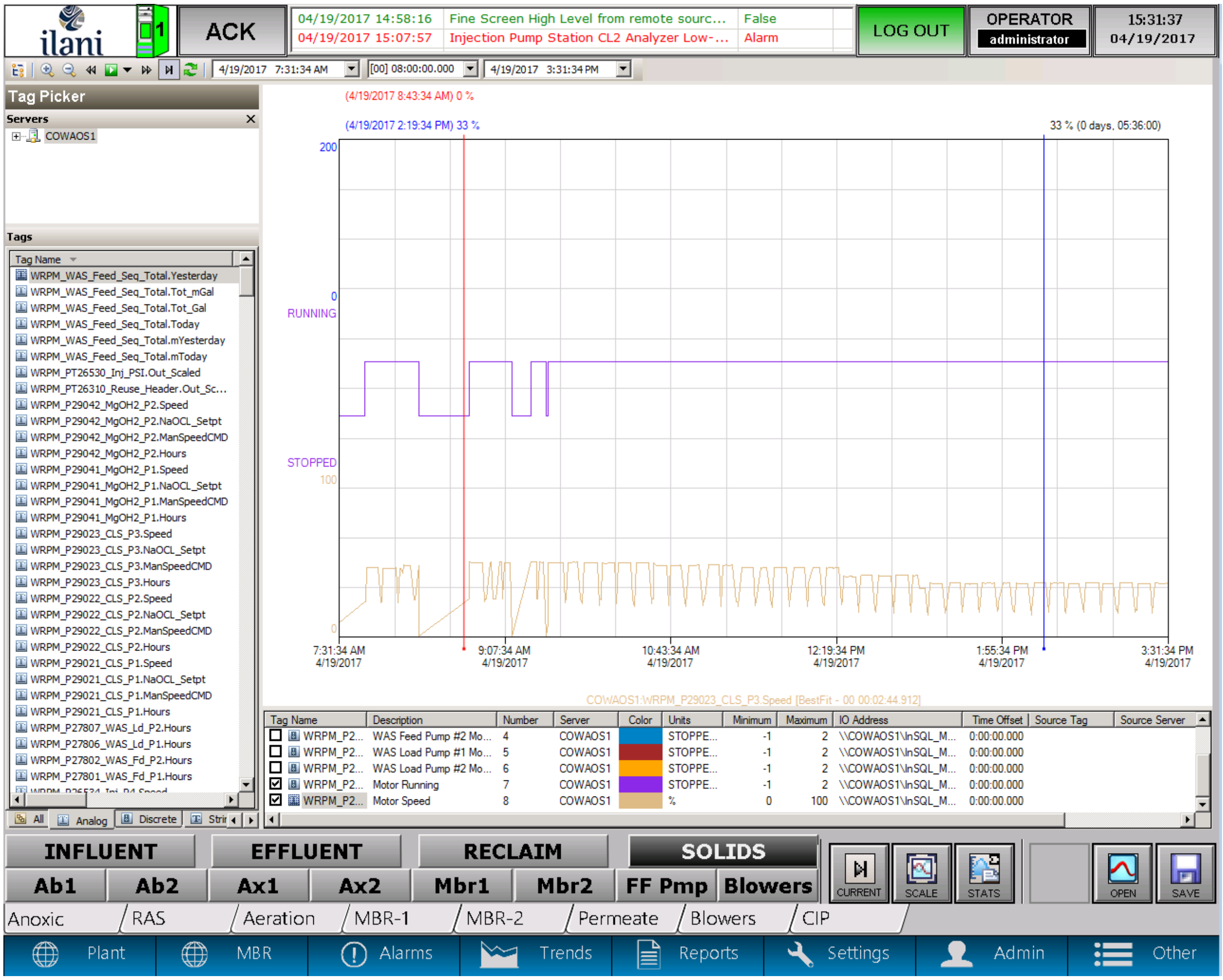

Figure D-24. Solids Trend Screen

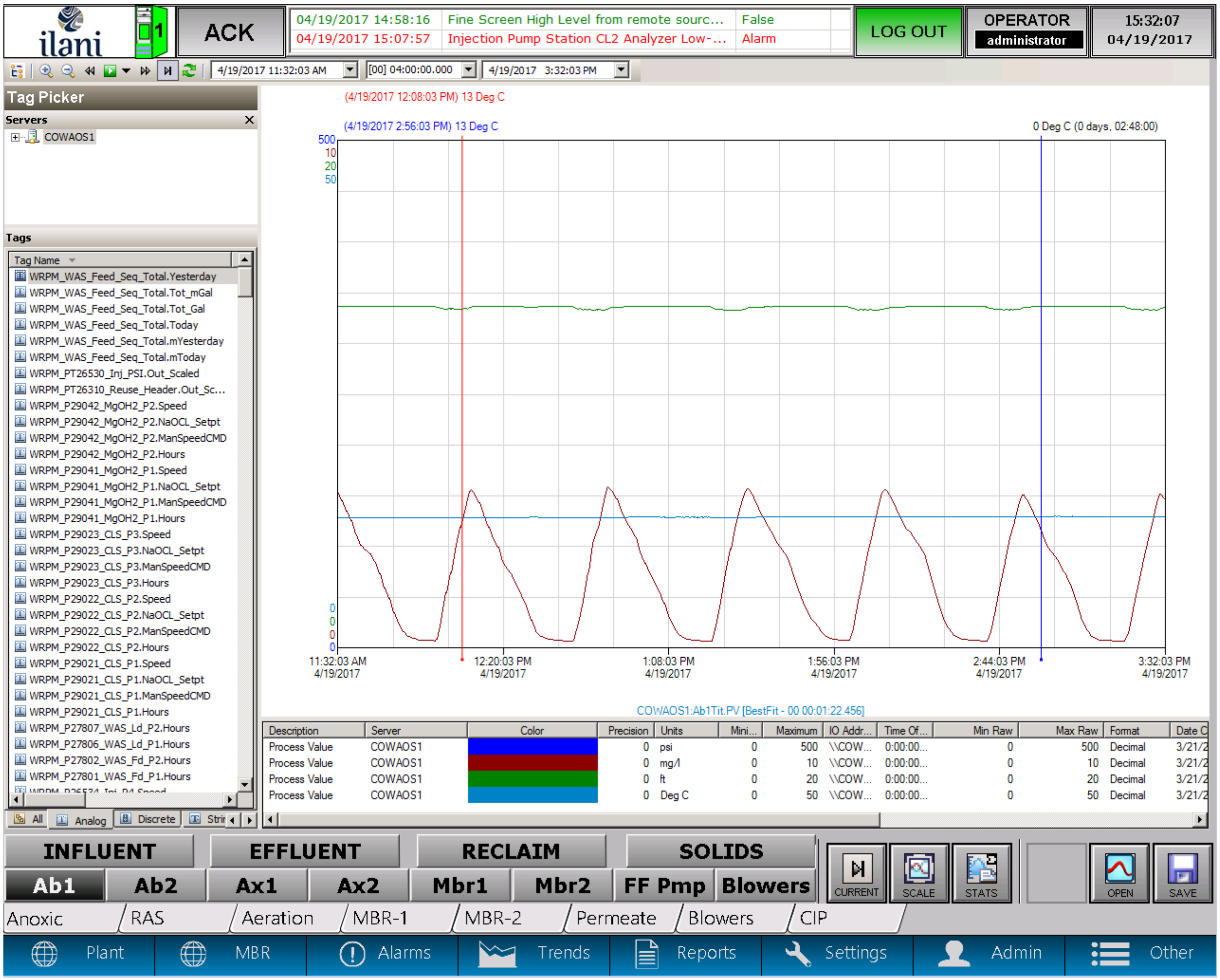

Figure D-25. Aeration Basin 1 Trend Screen

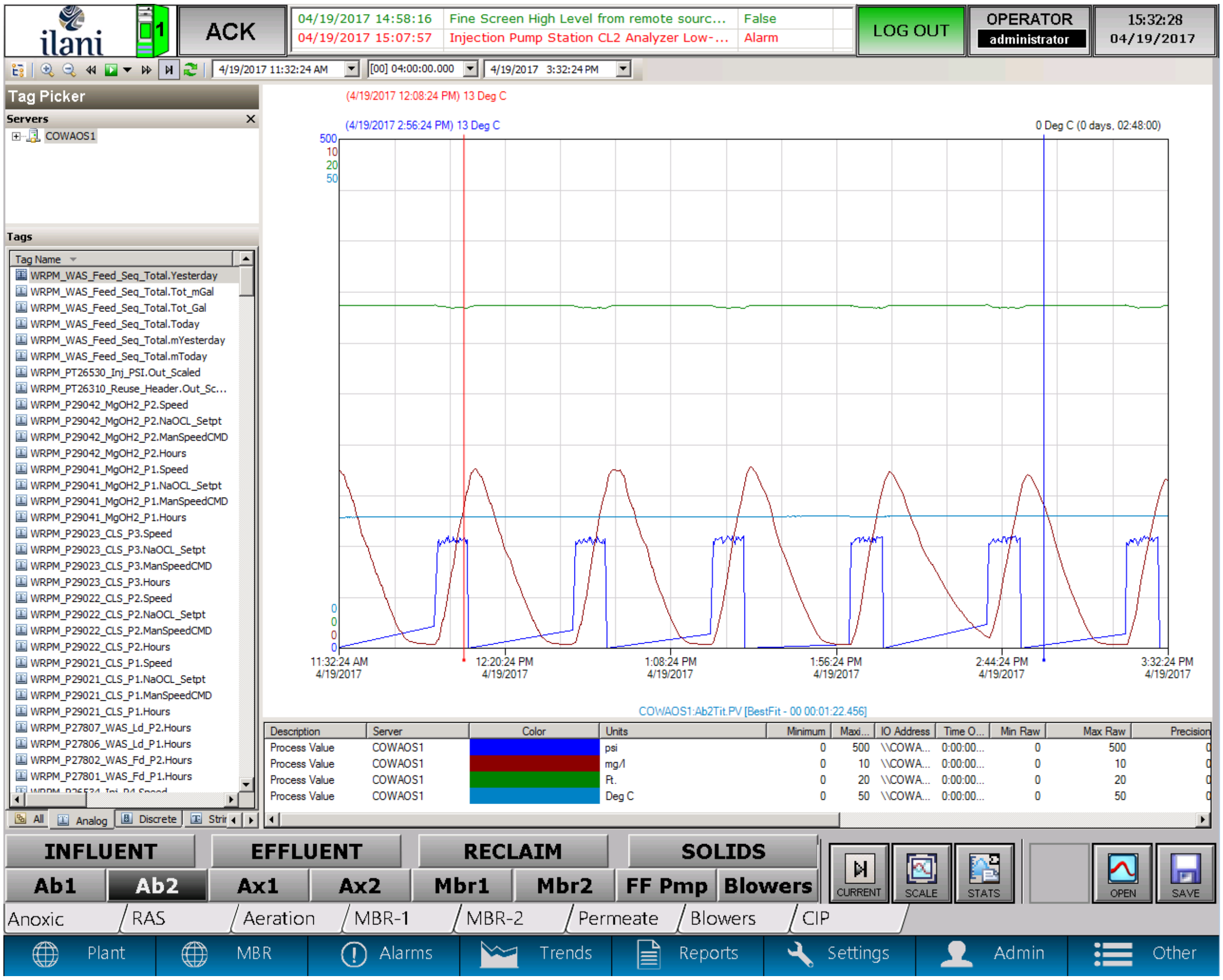

Figure D-26. Aeration Basin 2 Trend Screen

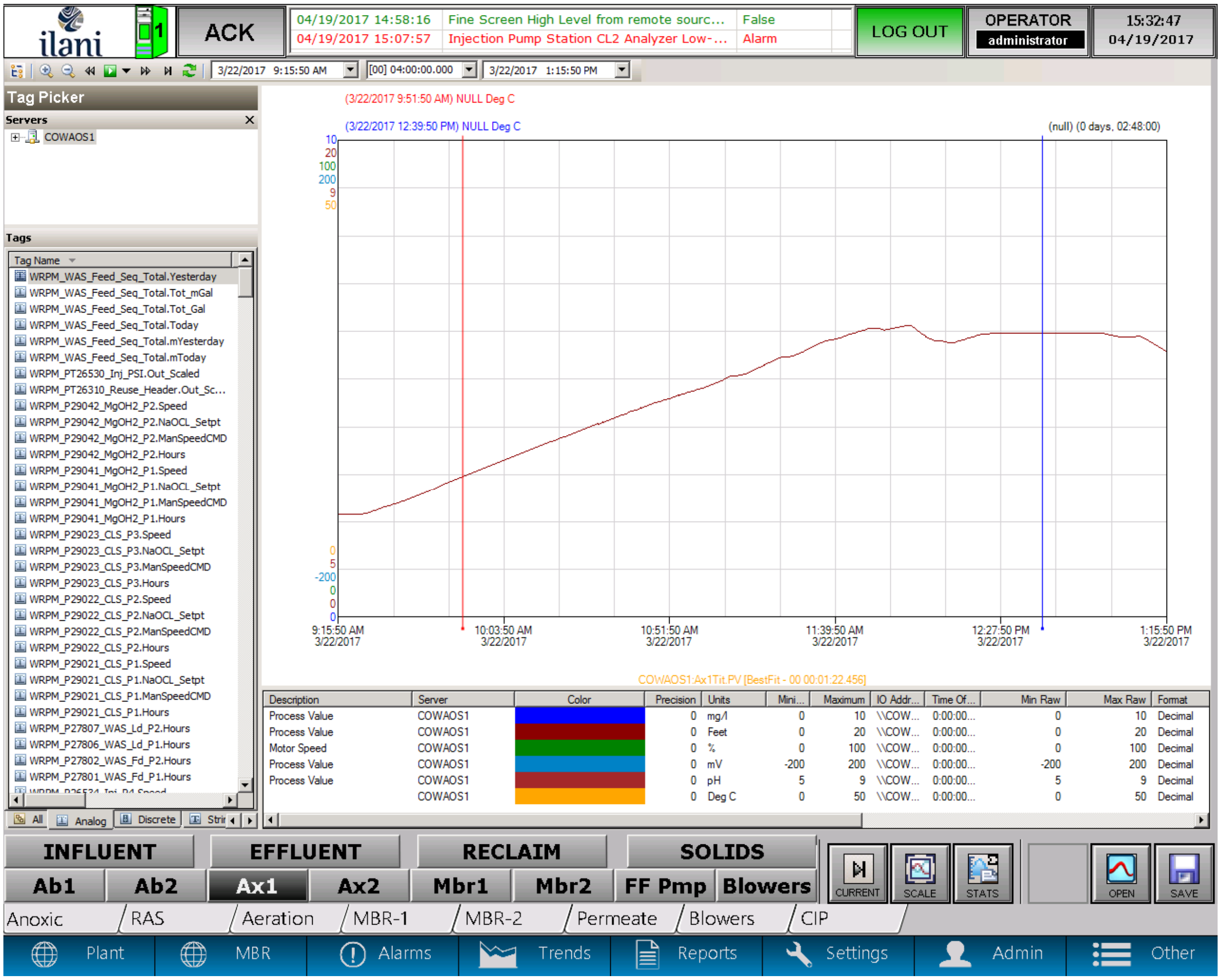

Figure D-27. Anoxic Basin 1 Trend Screen

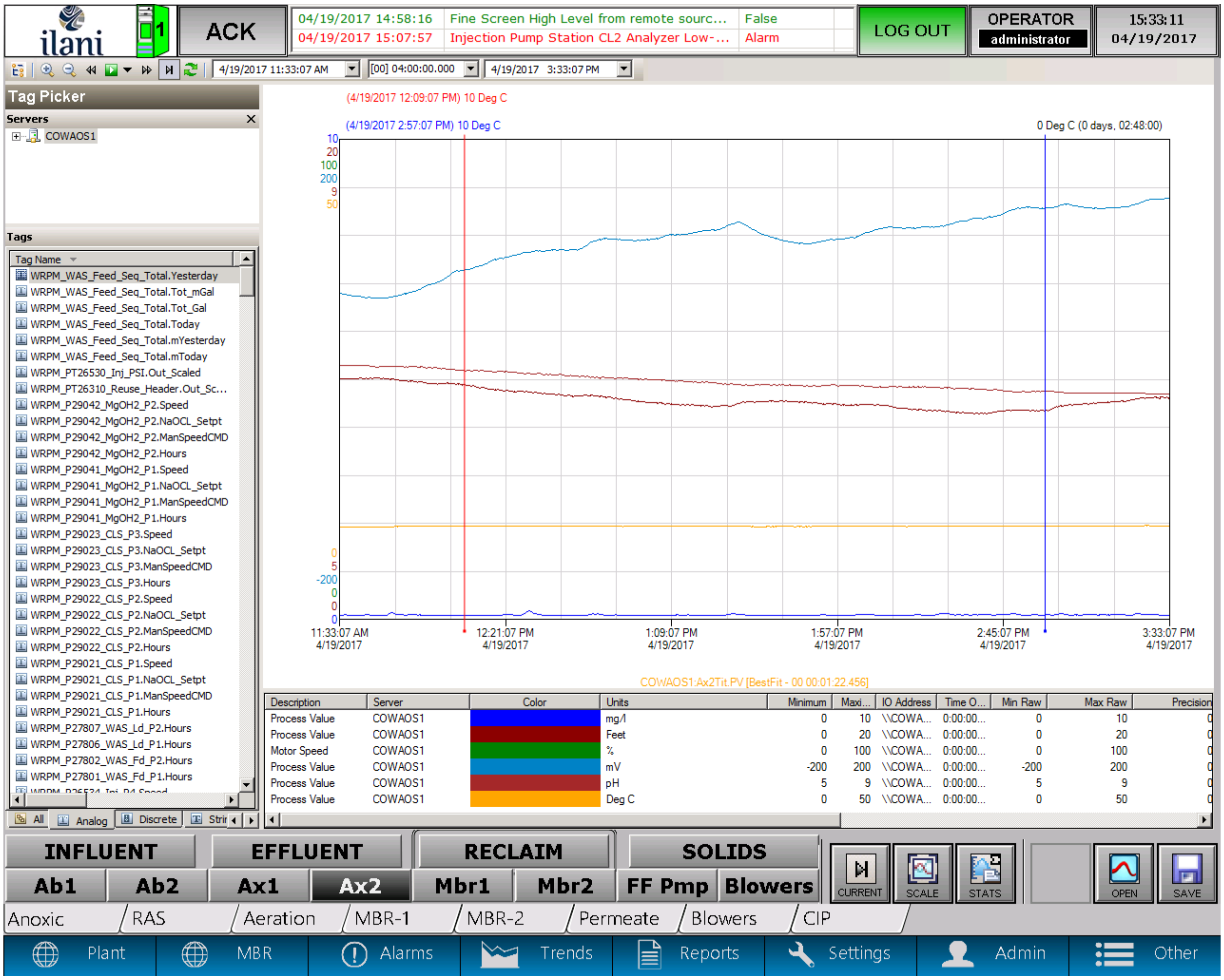

Figure D-28. Anoxic Basin 2 Trend Screen

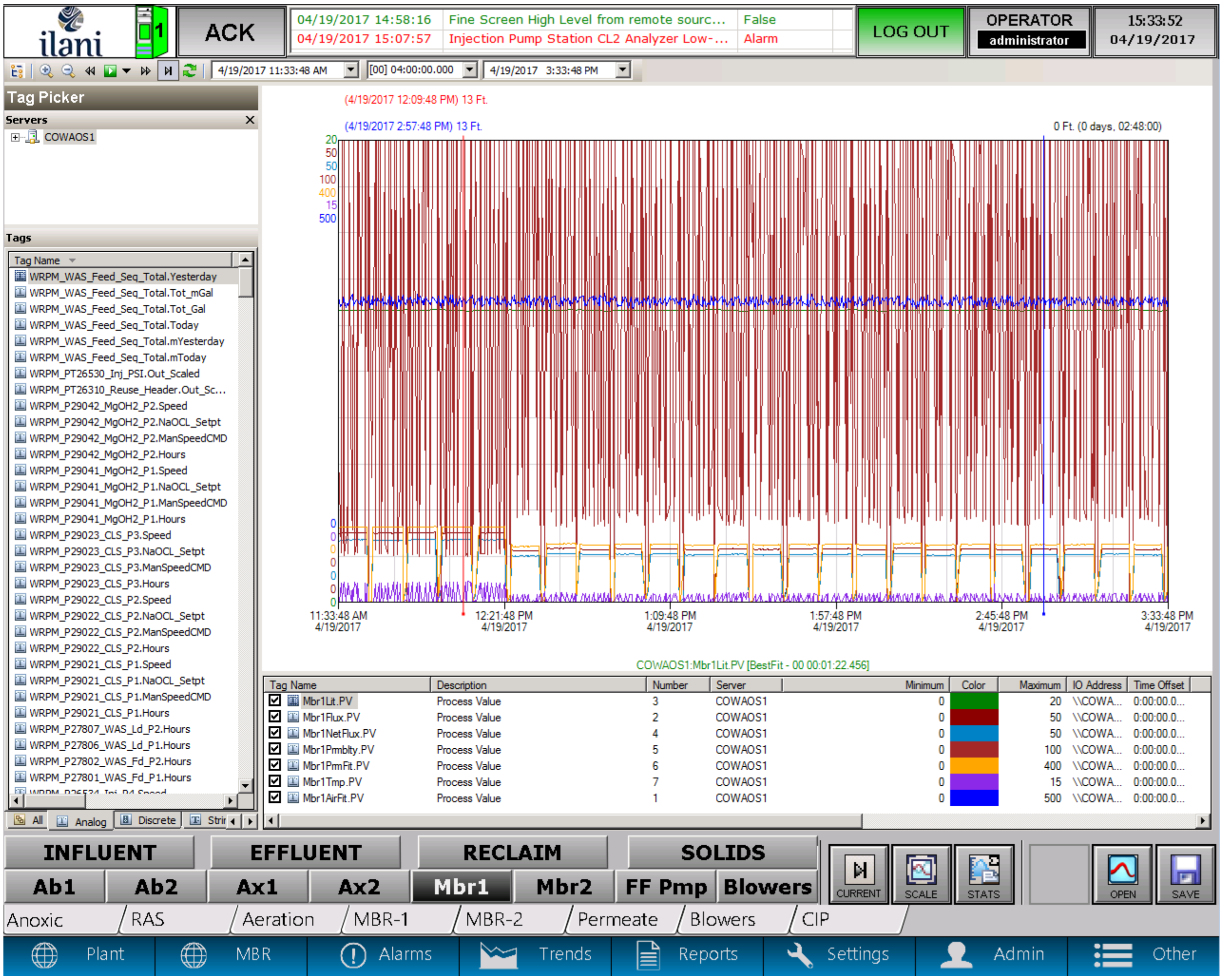

Figure D-29. MBR Basin 1 Trend Screen

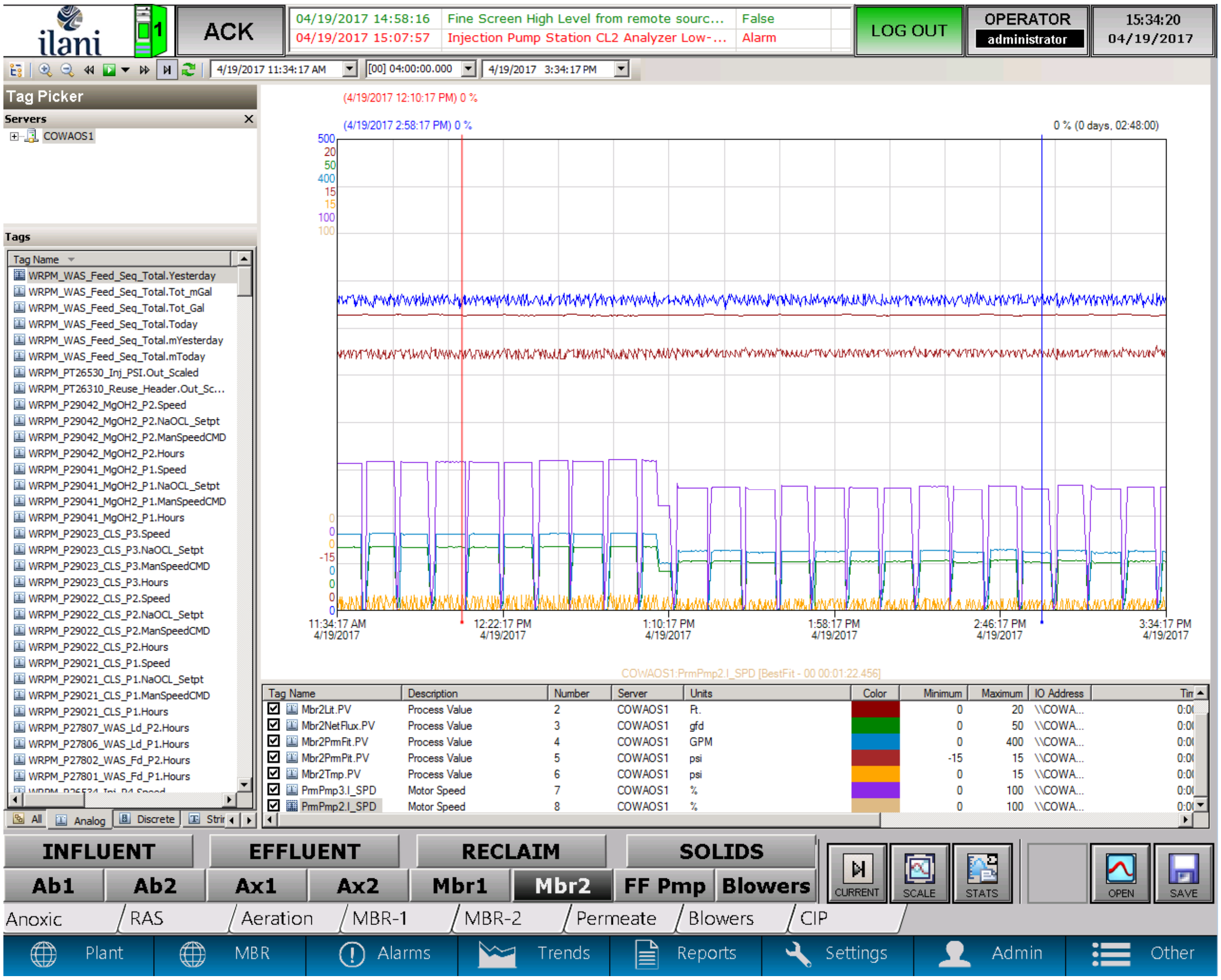

Figure D-30. MBR Basin 2 Trend Screen

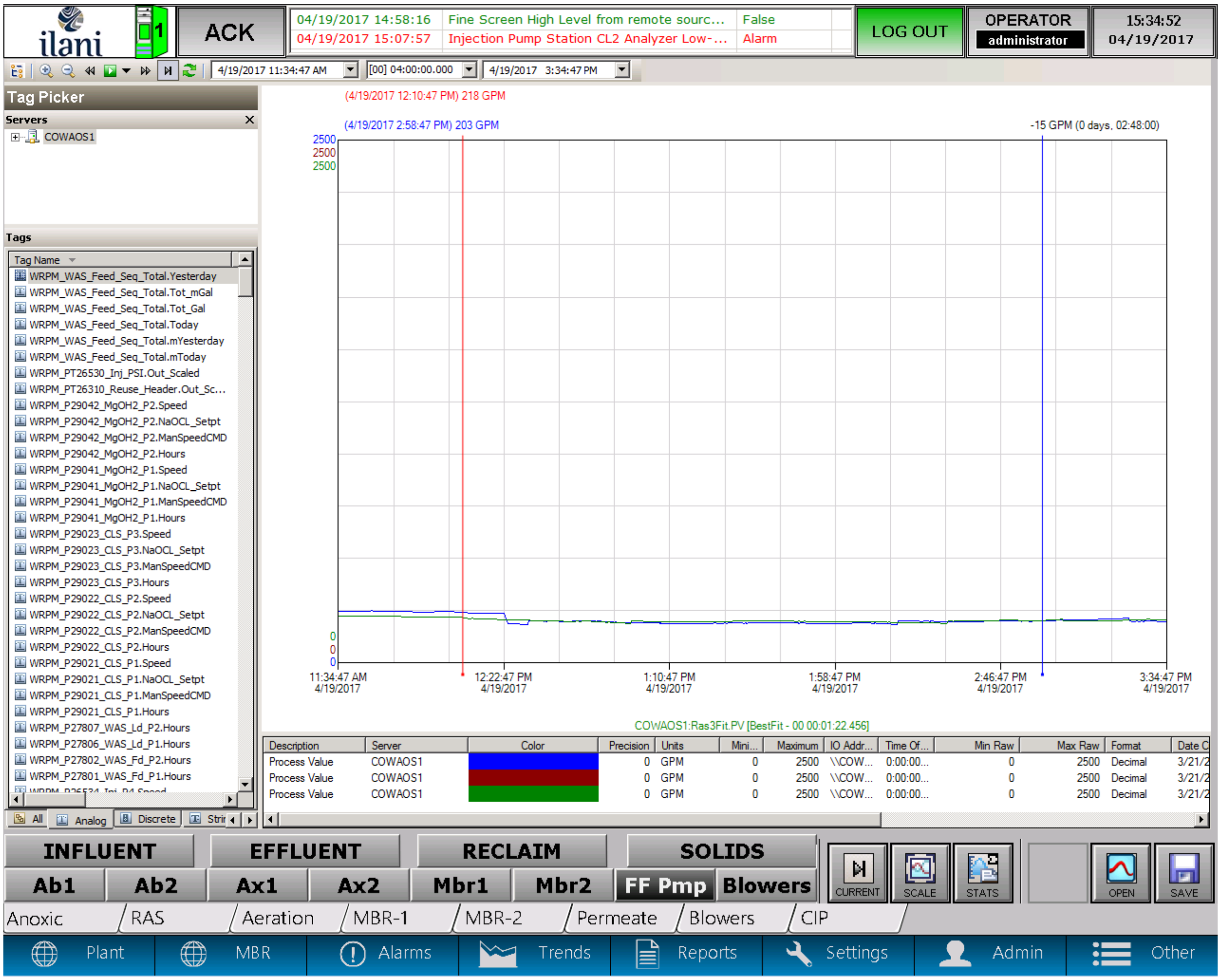

Figure D-31. Feed Forward Pump Trend Screen

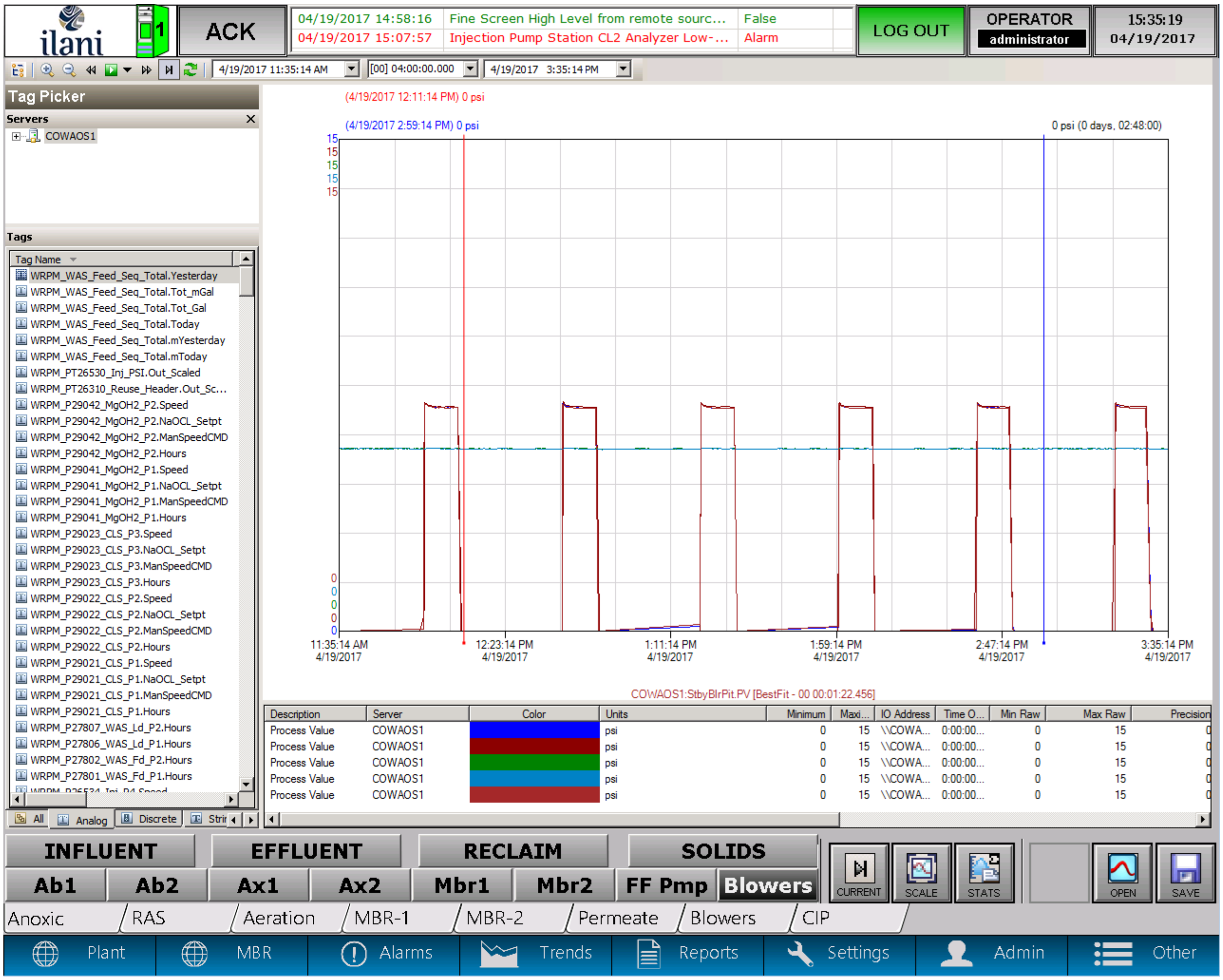

Figure D-32. Blower Trend Screen

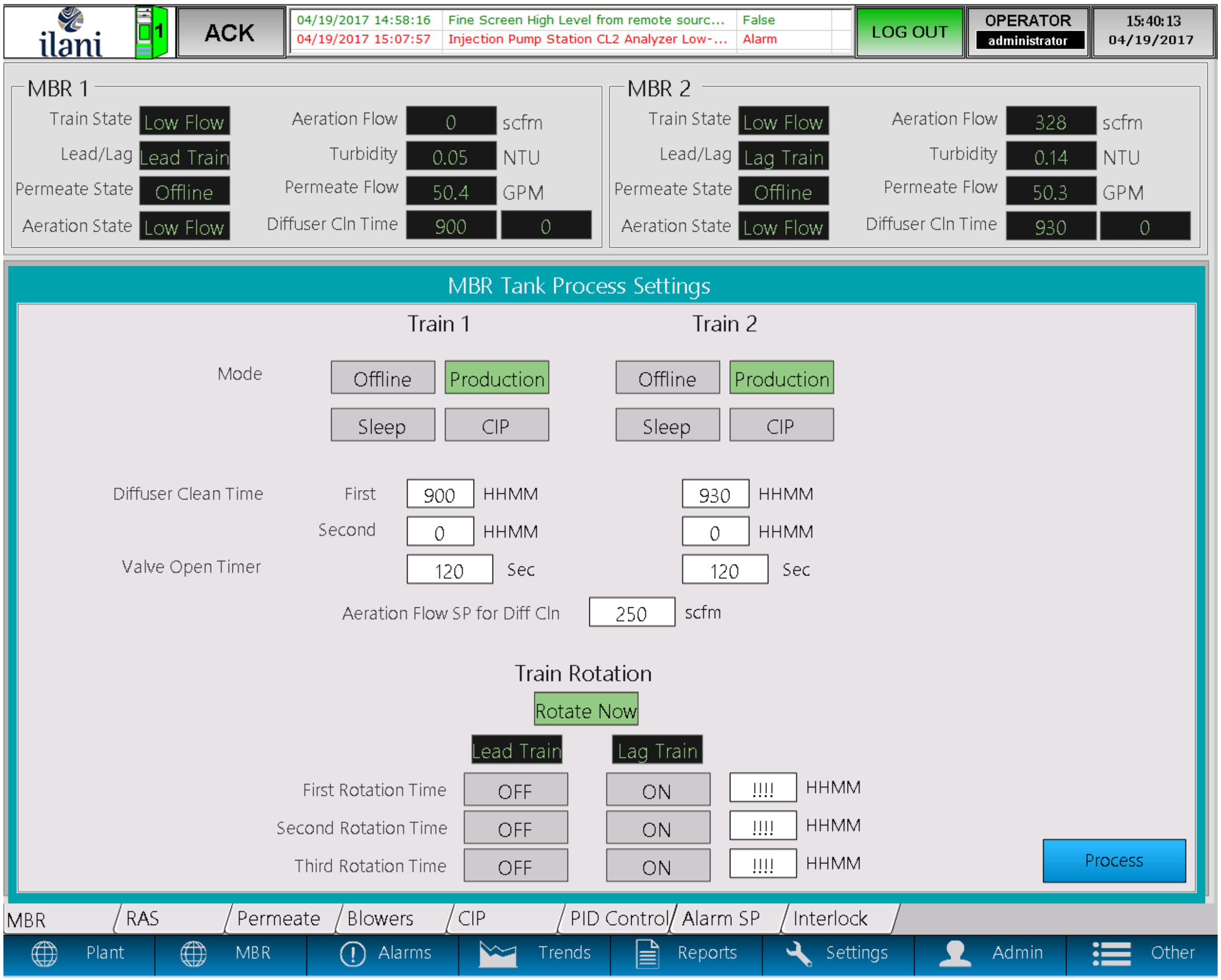

Figure D-33. MBR Train1 and Train 2 – Setting Screen

Figure D-34. Feed Forward – Setting Screen

Figure D-35. Permeate – Setting Screen

Figure D-36. Blower – Setting Screen

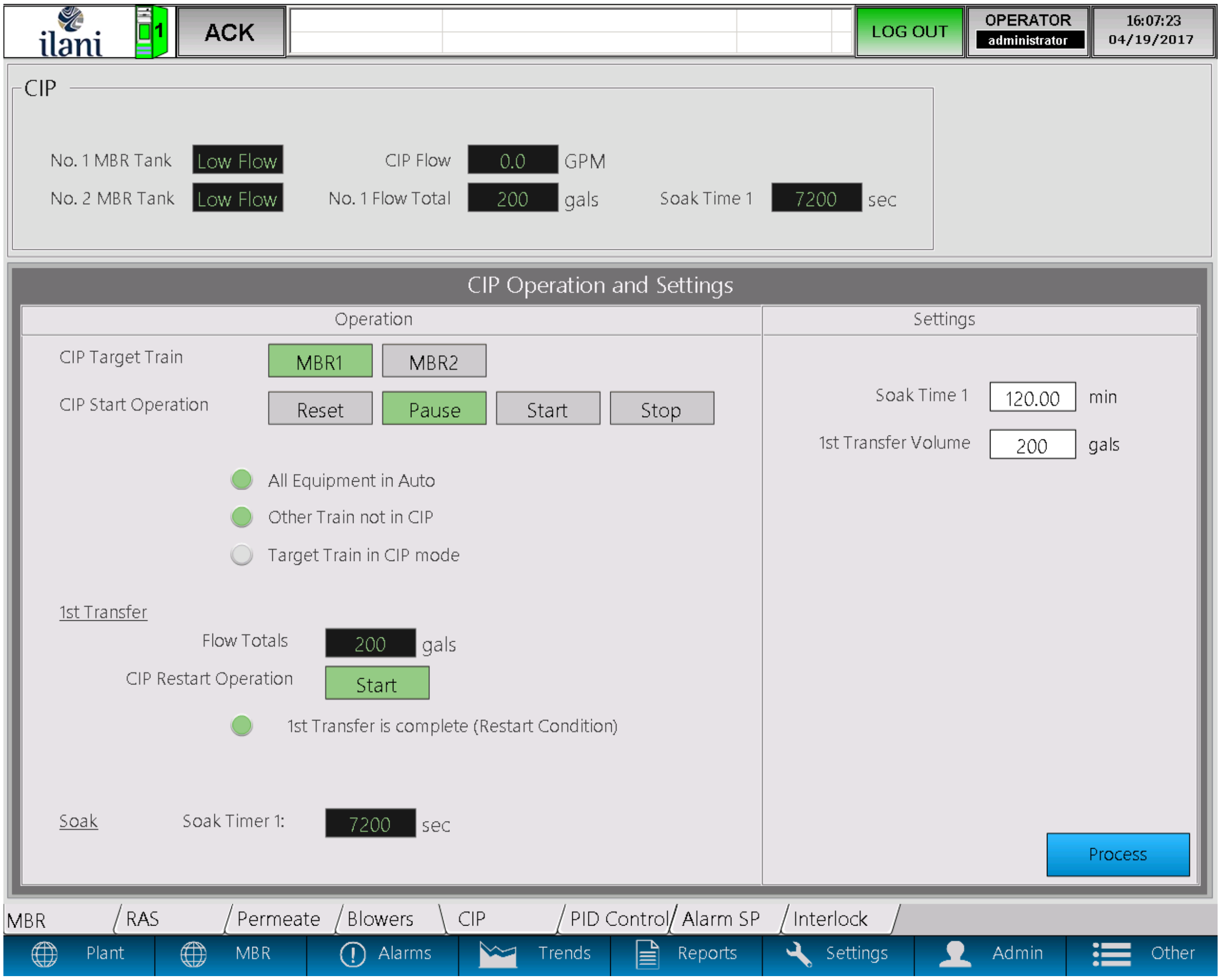

Figure D-37. Chemical In Place – Setting Screen

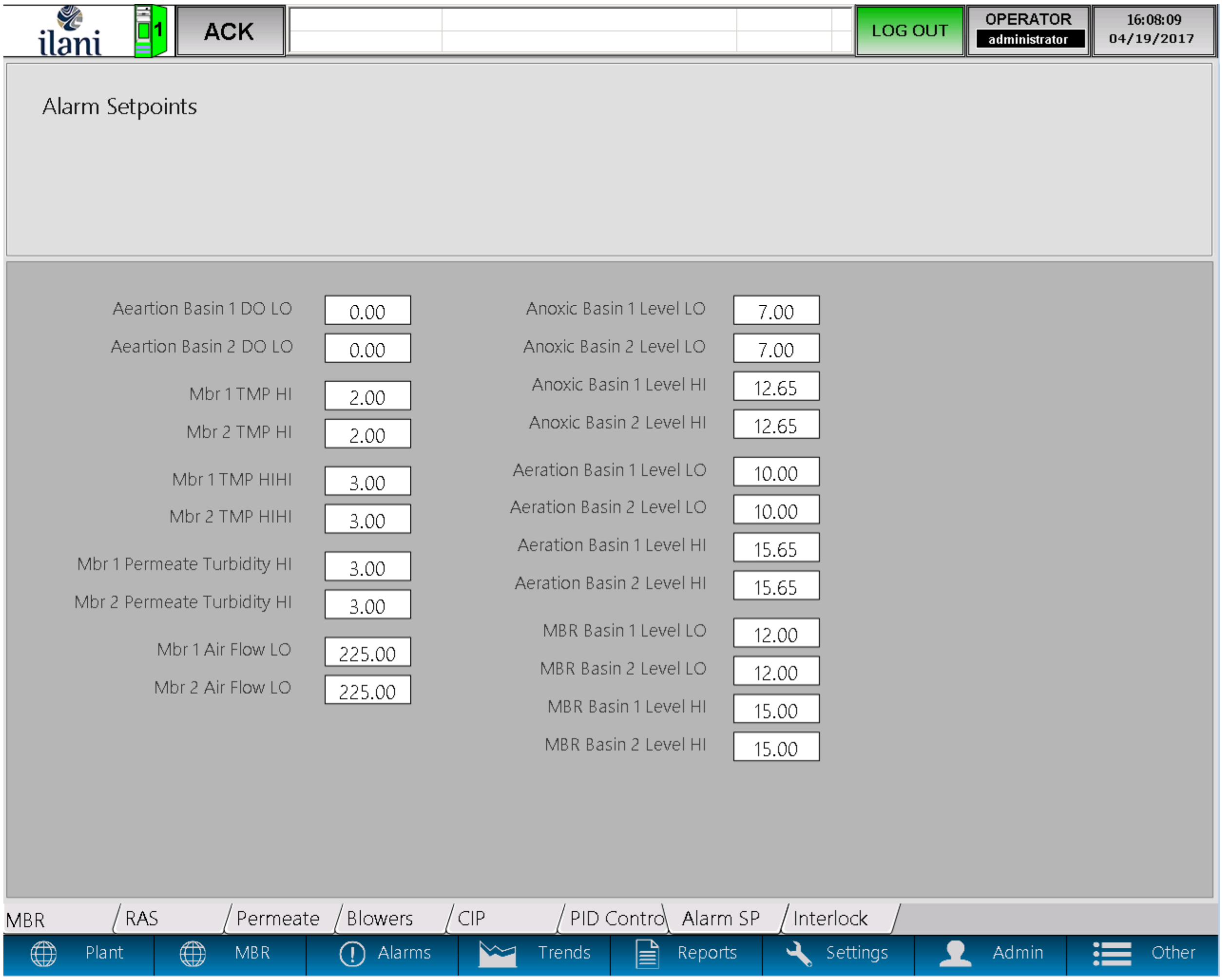

Figure D-38. Alarm – Setting Screen

Figure D-39. Interlock – Setting Screen

Appendix E

Vadose Zone Well Reports

RECLAIMED WATER INFILTRATION WELL AS-BUILT REPORT
COWLITZ RESERVATION DEVELOPMENT

MARCH, 2017

RECLAIMED WATER INFILTRATION WELL AS-BUILT REPORT
COWLITZ RESERVATION DEVELOPMENT

Prepared for:

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March, 2017
JE1510
as-built rpt v3

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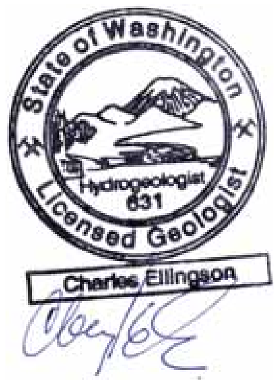
TABLES

FIGURES

APPENDICES

SIGNATURE

This report, and Pacific Groundwater Group's work contributing to this report, were reviewed by the undersigned and approved for release.



Charles Ellingson
Principal Hydrogeologist
Washington State Hydrogeologist No. 631

1.0 INTRODUCTION

This report documents the installation of six reclaimed water infiltration wells at the Cowlitz Reservation development in 2016. Although the wells infiltrate water under gravity, they are Class V injection wells according to the Code of Federal Regulations (CFR), Part 40, subpart F. The wells were installed by Hansen Drilling and Tacoma Pump and Drilling, as subcontractors to PSI and Swinerton Builders, the general contractor for the development. Pacific Groundwater Group acted as hydrogeologist, and was a subconsultant to Parametrix, Inc., the reclaimed water plant designer.

This report provides the following informational requirements of 40 CFR 144.26 (2):

- Date of well completions (Appendix A).
- Identification of depths of the formation into which infiltration occurs (Appendix A).
- Total depth of wells (Appendix A, Table 1).
- Casing and cementing record, tubing size, and depth of packer (Appendix A[1]).
- Average and maximum injection pressure[2] at the well head (Section 5, Table 2).
- Average and maximum injection rate (Section 5, Table 2).

The report also recommends which wells to use initially, general well operations plans, and guidelines for placement of monitoring wells.

The work was performed, and this report prepared, in general accordance with generally accepted hydrogeologic practices, for specific application to the Cowlitz development, and for sole use by Parametrix Inc. This is in lieu of other warranties, express or implied.

2.0 INFILTRATION WELL DESIGN APPROACH

This section summarizes the design of the infiltration wells and preliminary plans for operation of the wells. Section 3 summarizes the wells as they were installed.

Pacific Groundwater Group recommended an infiltration wellfield consisting of six large diameter wells (Figure 1), plus the conversion of a smaller diameter test well[3]. Wells were designed to be screened in the unsaturated Upper Troutdale Formation, and extend into the unsaturated Sand and Gravel Aquifer. Preliminary design calculations were based on a design flow that slightly exceeded the expected maximum daily flow, site conditions tested during the feasibility study, 16-inch boreholes, total well depths of 180 ft below ground, 75 ft long well screens, gravity infiltration with heads not higher than 30 ft below ground, a safety factor of 2 to accommodate some uncertainty and plugging, and a redundancy of 1.5.

Through a design process, the dual rotary drilling method was selected for installation of 12-inch diameter PVC wells in 16-inch boreholes, with a 20-inch diameter surface seal surrounding the 16-inch diameter steel casing, enough of which was retained to extend through surficial low permeability soils that extend to a depth of about 70 ft. A 4x8 sand pack was specified for filling the annular space outside the 12-inch

---

1 Packers were not used.
2 The wells are gravity infiltration wells, not injection wells.
3 Pacific Groundwater Group, July 2015, Reclaimed Water Infiltration Feasibility Assessment, Cowlitz Reservation Development.

well to ground level; however, insufficient volume of that material was available, and 1/4x1/8 sand was thus also used. Sumps (non-screened areas) were designed for the bottom 20-ft of the wells.

Based on a recommendation by Gary Small of HydroSystems, Inc., flow to the wells was designed to be controlled by V-smart valves (ASR Resources, Sun Lakes, AZ). These valves will be installed at the bottom of the down-comer tubes to prevent entrainment of air into the downward flowing water, and are controllable by a programmable logic controller (PLC).

With the assistance of Gary Small of HydroSystems, Inc., it was envisioned that a minimum number of primary infiltration wells would be identified once test data were available. Primary well(s) would be used to infiltrate as much reclaimed water as possible, for as long as possible within the limits of gravity infiltration (the wells will not be pressurized to heads above ground level).

Backup wells were planned to augment, and then replace, primary wells as the capacity of primary wells declines. For infiltration of reclaimed water, which has very low suspended solids, infiltration capacities are likely to decline primarily as a result of biomass growth in the near-well soil, which reduces hydraulic conductivity. The water will be chlorinated, which should retard the growth of biomass but is not likely to eliminate it. Clogging with mineral grains may also contribute to reduced infiltration capacity. Because the wells by design are completed in the unsaturated zone, there is no practical method to redevelop the wells once they are plugged. Additional discussion of clogging in the context of wellfield operations is included in Section 5.

3.0 WELL INSTALLATION

The information presented on Table 1 and the well logs (Appendix A) is derived from PGG observations and communication with drillers. Wells were drilled in general accordance with the plans and specifications. PGG was onsite for much of the drilling and testing, but not all of it. The following paragraphs discuss variations in well construction made during field work. Table 1 and the well logs of Appendix A also contain well construction data.

Total well depths were all near 180 ft as planned, but lengths of sumps and well screens varied. Exposed screens varied from 62 to 95 feet long, and bottom sumps varied from 9 to 50 ft long. Wells were screened primarily in the Upper Troutdale Aquifer (UTA), but most screens extended into sands at the top of the Sand and Gravel Aquifer (SGA), which is also unsaturated below the site.

The drilling method was modified based on results at the first well drilled (Well 3), which indicated low capacity. The driller used water to enhance removal of cuttings and cool the downhole steel during drilling of Well 3 and did not cut the drive shoe prior to pulling back to expose the screen. All other wells were drilled using only air to lift cuttings in the UTA and SGA. The driller also increased the open hole interval between the drill bit and the casing. Finally, the driller cut the drive shoes prior to installing the screens which allowed the casing to be pulled back with minimum spinning during screen placement. Although the five wells installed after these changes were made are all more productive than Well 3, variation in geology also exists, and likely contributes to differences in productivity. The exact contributions of geology, drilling, and construction differences to well productivity are not known.

Well 1 (conversion of test boring B6) was not constructed as of the time of this writing and is not considered in well use recommendations of Section 5.

Hansen Drilling shot videos of all wells except Well 3 where PSI directed them not to run the video. Video logging of Well 2 indicates entry of fine sand into the lower portions of the screened interval, likely caused by failure to place sand pack between 144 and 149 feet depth. About 2 feet of fine sand has accumulated in the tail pipe of this well. The fine sand is likely to compromise the performance of the well since the water stream will tend to suspend the sand during operation which will act to plug the formation. We recommend that the contractor recommended alternatives to correct this situation or alternatively replace the well if corrective actions cannot be taken. Any corrective action should provide for at least 10 feet of tail pipe (sump).

4.0 SHORT WELL TESTS

Two-hour infiltration tests were completed after the wells were installed. Water was derived from well B-1R, and was piped to each well. Turbidity of water prior to testing was generally less than 1 NTU.

The tests indicate that Wells 4-7 are the most productive with infiltration rates during testing ranging from 66 to 70 gpm at an infiltration water level of about 130 feet below ground surface (Table 1). Note the well screens extend upward to 70 ft bgs and designs assumed water levels as high as 30 ft below ground – thus maximum initial well capacities are higher than rates used for testing. Well 2 showed lower capacity with infiltration rate of 56 gpm at an infiltration water level of about 80 feet bgs. Well 3 was only able to accept 6 gpm at an infiltration water level of about 80 feet bgs.

Infiltration rates commonly declined slowly during the constant head portions of the tests in response to development of the flow regime around the well. The decline in flow rates was projected into the future to estimate an "initial operational flow rate". That flow rate is our estimate of the flow rates that would occur at the tested infiltration head after full establishment of the flow regime around the well. The initial operational flow rates were used in further calculations.

Analysis of the short-term infiltration test data for Wells 4, 5, and 6 indicate effective hydraulic conductivities (K) of between 7 and 9 ft/day for the screened portions of the SGA. Prior testing of the SGA unit during the feasibility study indicated lower K values on the order of 0.5 to 1.1 ft/day. The new K values for the SGA also appear to be higher than most of the UTA test results which mostly ranged between 1.3 and 3 ft/day with one outlier of 22 ft/day (as measured during the Feasibility Study).

5.0 INITIAL USE OF WELLS

We recommend that Well 6 be used as the primary infiltration well during initial system operation and Well 4 be the first backup well (Figure 1). These wells are both relatively productive and are roughly aligned with groundwater flow near the center of the wellfield. This will facilitate placement of the two new monitoring wells downgradient of infiltration (Section 6). Table 2 summarizes expected initial operating conditions assuming that each well receives either 100,000 gpd, or 200,000 gpd (gallons per day). Although all wells are included in Table 2, Well 6 is recommended as the only initial primary well, and no other wells should initially be required. We understand that the water level required to infiltrate 200,000 gpd can be measured during the planned clean water test as a check on the estimated values in Table 2.

Operating water levels should rise over time as a result of clogging if infiltration rates in a particular well are constant. After the maximum recommended infiltration water level of 30 ft below ground is attained, the flow rate to that well must be decreased to prevent exceeding the maximum water level. Both flow rates and water levels will be automatically monitored by equipment tied to the PLC.

The rate of clogging can only be assessed as the wells are operated. For the feasibility study we assumed a 2x reduction in K to accommodate some degree of clogging into feasibility considerations, plus we recommended a 50% redundancy in the number of wells. We have NOT used safety factors in the calculations of Table 2. The well capacities reported in Table 2 are based on the initial operational flow rates. These updated calculations indicate that the wellfield is more than sufficient to infiltrate the planned flows until clogging severely reduces the capacity of several wells, and wells need to be replaced. The clogging-dependent well lives can only be learned through operation and monitoring.

Wells should be replaced before the needs of the development exceed the capacity of the current wellfield to efficiently infiltrate water. Additional well locations are included in the wellfield layout. Replacement wells could be located near wells that are no longer used to take advantage of existing piping since clogging problems will be confined to the immediate vicinity of the well. The following conditions are recommended for discontinued use of a well and well replacements. These criteria are preliminary and should be reconsidered after operational knowledge is developed:

- Operate the minimum number of wells necessary.
- Keep unused wells clean, dry and closed to the reclaimed waterline with manual shutoff valves.
- Discontinue well use when the infiltration water level in the well rises to 30 ft below ground level and when infiltration capacity diminishes to 25% of the average daily flow.
- Use existing backup wells until the remaining wellfield capacity (not including wells with capacities less than 25% of average daily flow at a water level 30 ft below ground) declines to 1.5 times the maximum daily flow, then consider replacement of several wells at once.
- Notify EPA of well replacements.
- Review wellfield capacity prior to large increases in reclaimed water flows.

6.0 MONITORING WELL PLACEMENT

Logs for the two additional planned monitoring wells will be provided after the wells are drilled, which is scheduled for late March to early April, 2017. Collection of samples from monitoring wells should be in general accordance with EPA's latest sampling protocol.[4] A sample should be collected for the approved set of parameters before infiltration of reclaimed water; however, a sample collected soon after infiltration starts may also serve as a background sample.

To guide monitoring well placement, PGG modeled infiltration from Well 6. Downward flow in the vadose zone flow is expected to spread out around Well 6. The shape of spread was approximated as a circle of radius 75 ft for flow of 100,000 gpd, and 107 ft for flow of 200,000 gpd. Those calculations were made using Darcy's equation and assume a unit downward hydraulic gradient and a vertical hydraulic conductivity of 0.75 ft/day. That hydraulic conductivity is 10x smaller than the effective (non-directional) hydraulic conductivity measured during testing of Well 6 (ie: we have assumed an anisotropy factor of 10x).

[4] Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers. US Environmental Protection Agency, 2002. EPA 542-S-02-001. Check for updates.

The USGS Modflow model reported in our Feasibility Study report of July 2015 (and supplemental report to EPA of April 2016) was used to simulate flowlines of reclaimed water movement below the SGA water table which occurs at about 250 ft depth. The water was assumed to reach the water table in the circular area around Well 6 described above. Figures 1 and 2 show the flowlines for 1 and 5 years of flow downgradient from the water table below Well 6. Small groundwater mounds of 1 and 2 feet are predicted by this modeling for flows of 100,000 gpd and 200,000 gpd.

The 2015 and 2016 reports included sensitivity model runs assuming lower aquifer transmissivity. Sensitivity runs were not repeated for the current analysis because they will not affect monitoring well placement.

The monitoring wells should be placed downgradient of Well 6, within the set of flowlines shown on Figure 1. Appropriate locations for the monitoring wells are included on Figures 1 and 2 but other nearby locations within the flowlines would also be acceptable. Well MW-1 can be moved toward the wellfield and still meet its purpose. We recommend that MW-2 be placed approximately 50 ft from Well 6.

Table 1. Selected Infiltration Well Construction and Test Data

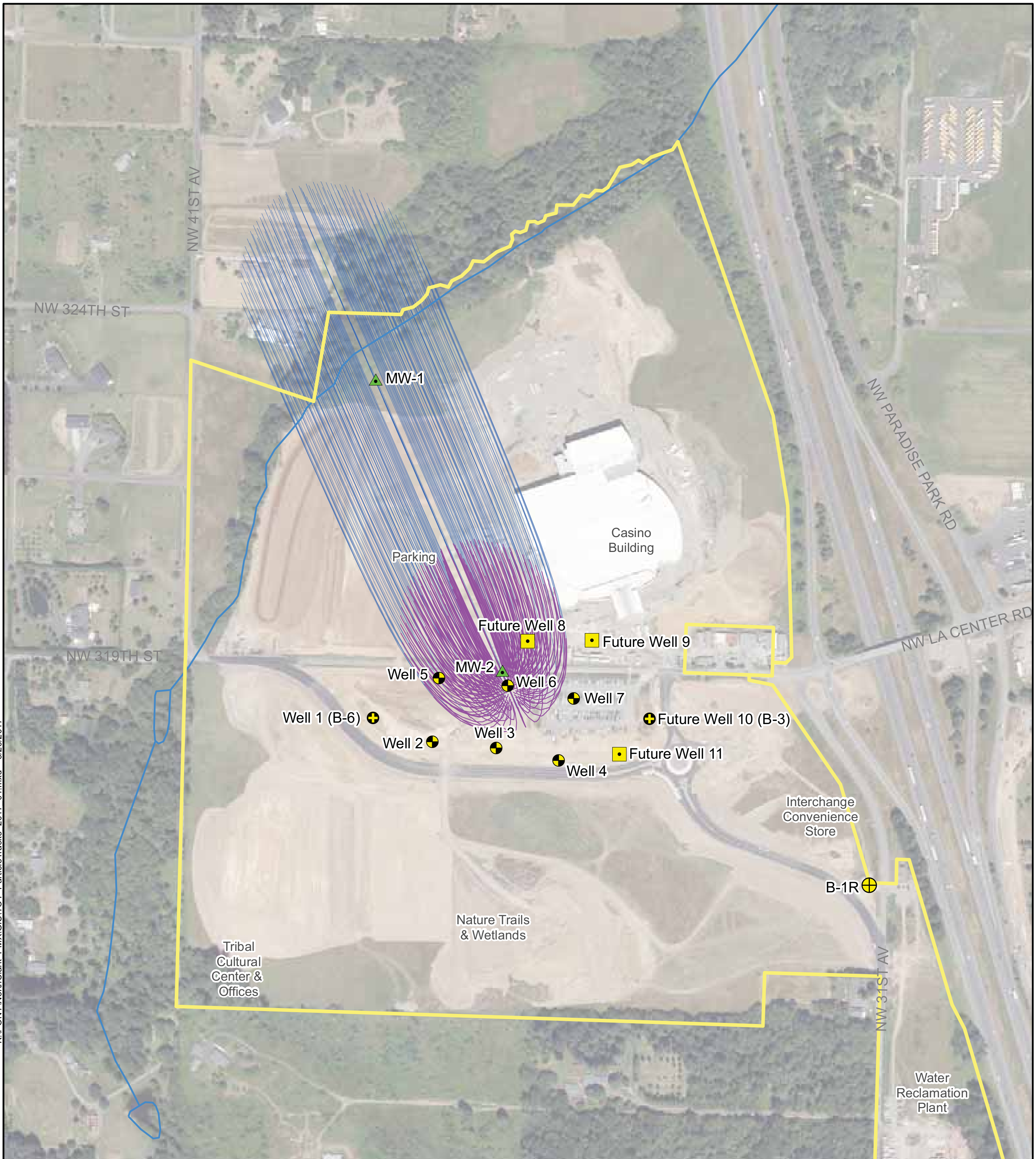
Well #	Boring Depth (ft)	PVC Well Depth (ft)	Sand Pack Interval (ft bgs)	Exposed Screen length (ft)	Sump Length (ft)	Exposed Screened Interval (ft bgs)	Steady Water Level During Infiltration (ft)	Flow Rate near End of Test (gpm)	Estimated Initial Operations Flow Rate at Tested Water Level (gpm)
1*									
2	180	170	0-180	80	20	70-150	80.75	56	48
3	180	175	0-180	61	50	64-125	79.40	6	10
4	180	175	0-180	95	10	70-165	130.40	70	60
5	179	165	0-174	80	15	70-150	130.79	66	63
6	180	179	0-180	80	9	70-130 and 150-170	130.40	70	70
7	180	176	0-180	95	10	71-166	130.00	70	61

* Well 1 was not constructed or tested at the time of this report.

Table 2. Estimated Initial Operating Water Levels

Well No.	Q=100,000 gpd	Q=200,000 gpd
Well 2 (future)	60 ft bgs	Q exceeds well capacity
Well 3 (likely not used)	Q exceeds well capacity	Q exceeds well capacity
Well 4 (first backup well)	130 ft bgs	100 ft bgs
Well 5 (future)	128 ft bgs	108 ft bgs
Well 6 (first primary well)	130 ft bgs	107 ft bgs
Well 7 (future)	125 ft bgs	100 ft bgs

All values prior to the onset of clogging.



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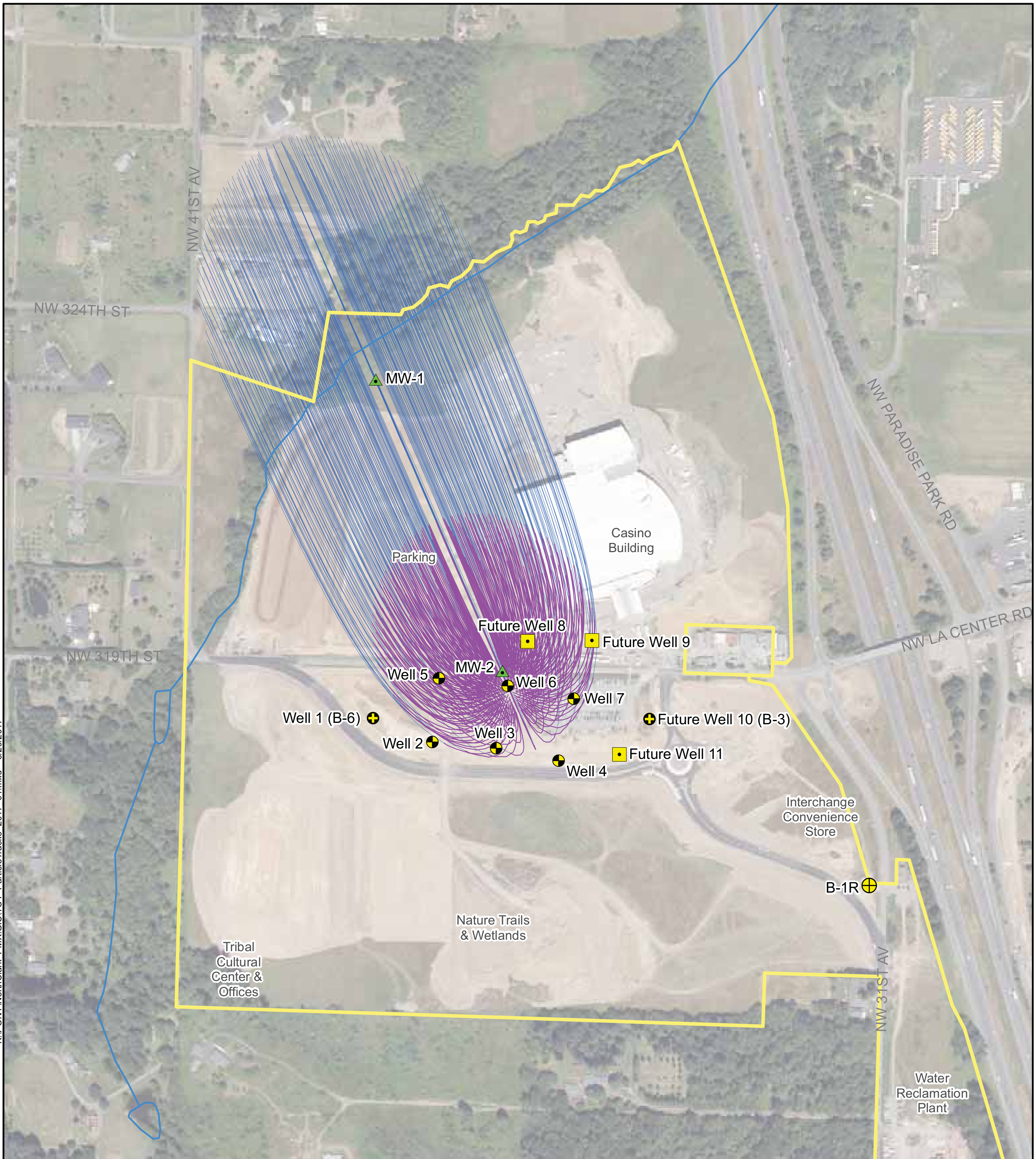
- Drilled Infiltration Well
- Existing Production Well
- Existing Test Well
- Proposed Future Infiltration Well
- Proposed Monitoring Well
- Property Line
- Modeled 1-Year Flow Path
- Modeled 5-Year Flow Path

0 Feet 500

2016 Aerial from Clark County

Figure 1
Modeled Flow Lines for 100,000 gpd Operating Rate

PGG



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- Drilled Infiltration Well
- Existing Production Well
- Existing Test Well
- Proposed Future Infiltration Well
- Proposed Monitoring Well

- Property Line
- Modeled 1-Year Flow Path
- Modeled 5-Year Flow Path

N

0 Feet 500

2016 Aerial from Clark County

Figure 2
Infiltrated Water Flow Lines at 200,000 gpd

PGG

APPENDIX A

INFILTRATION WELL LOGS

Depth (ft)	Geologic Unit	Description
0–64	PAD	Red to brown, CLAY and SILT. (obtained from drillers log)
64–70		Light brown, very silty, fine sandy, GRAVEL. (trace clay)
70–75		Cemented, light brown, silty, coarse sandy, GRAVEL. (cementation observed)
75–83		Loose, light brown, silty, sandy, GRAVEL.
83–90		Cemented, light brown, silty, sandy, GRAVEL.

Well Construction

0-ft to 20-ft Bentonite surface seal

0-ft to 70-ft 12-in schedule 80 PVC riser pipe

0-ft to 70-ft 16-in steel casing

70-ft bottom of 16-in casing

70-ft to 150-ft schedule 80 slotted PVC screen (80 slot)

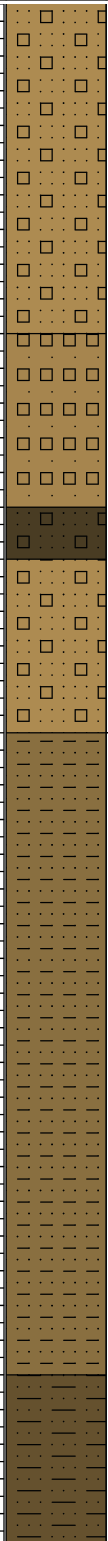
88-ft to 92-ft video log shows slight staining on well screen

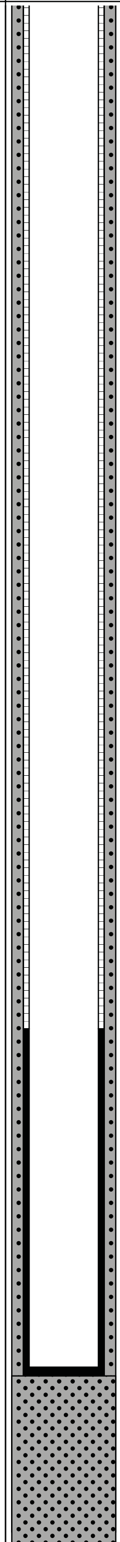
City, State: La Center, WA
Drilling Firm: Hansen/Tacoma Drilling
Drilling Method: Dual Rotary (AIR)
Date: 11/30/2016
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

Geologic Log and Well Construction Well 2

Cowlitz
Borehole Infiltration
JE1507

Depth (ft)	Graphic Log	Geologic Unit	Description	Test Zone	Well Construction
92–110		UTA	Loose, light brown, silty, fine to coarse sandy, GRAVEL. (oxidized) dense, harder at 93-ft BGS		0-ft to 180-ft 4x8 sand pack 109-ft to112-ft video log shows slight staining on well screen
110–120		UTA	Loose, brown to gray, slightly silty, fine sandy, GRAVEL. borehole will not stay open at 115-ft BGS		
120–123		UTA	Cemented, brown to gray, slightly silty, coarse sandy, GRAVEL.		
123–133		UTA	Loose, light brown, fine to coarse SAND and GRAVEL.		
133–170		SGA	Light brown, fine SAND. borehole will stay open uncased from 133-ft to 170-ft BGS small zone with gravel at 165-ft BGS		144-ft to 149-ft video log shows formation materials entering the well through PVC screen 150-ft to 170-ft schedule 80 PVC tail pipe 168-ft video log shows sediment in bottom of the tail pipe 169-ft to 170-ft perforated schedule 80 PVC tail pipe with 1/16-in holes and slotted bottom
170–180		SGA	Light brown, silty, fine SAND. (oxidized) Drilling got harder from 170-ft to 180-ft BGS		170-ft to 179-ft 4x8 sand backfill 180-ft bottom of boring, drill shoe cut and left at bottom of the hole





City, State: La Center, WA
Drilling Firm: Hansen/Tacoma Drilling
Drilling Method: Dual Rotary (AIR)
Date: 11/30/2016
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

Geologic Log and Well Construction Well 2

Cowlitz
Borehole Infiltration
JE1507

PgG

Depth (ft)	Graphic Log	Geologic Unit	Description	Test Zone	Well Construction
-2					
0					
2			Light brown, silty, CLAY. (Trace fine gravel, obtained from drillers log)		
4					
6					
8					
10					0-ft to 20-ft Bentonite surface seal
12					
14					
16			Light reddish, brown, silty, CLAY. (obtained from drillers log)		
18					
20					
22					
24					0-ft to 45-ft 12-in schedule 80 PVC riser pipe
26					
28					
30		PAD			
32					
34					
36					0-ft to 64-ft 16-in steel casing
38					
40					
42					
44					
46					
48					
50					
52					
54					
56					
58					
60			Cemented, light brown to brown, silty, sandy, GRAVEL.		
62					
64					64-ft bottom of 16-in casing and drill shoe
66					
68					
70					
72					
74			harder drilling, oxidized and observed cementation 70-ft to 74-ft BGS		45-ft to 125-ft schedule 80 slotted PVC screen (80 slot)
76					
78					
80			Loose, light brown, slightly silty, SAND and GRAVEL.		
82					
84					
86					0-ft to 180-ft 4x8 sand pack
88					
90					

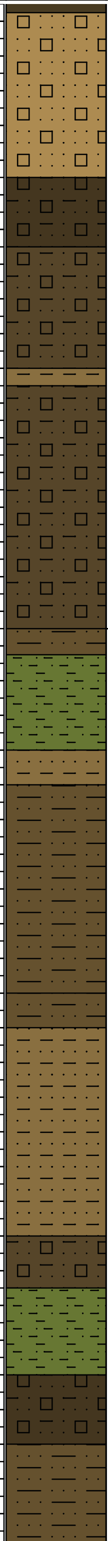
City, State: La Center, WA
Drilling Firm: Hansen/Tacoma Drilling
Drilling Method: Dual Rotary (AIR/WATER)
Date: 11/11/2016
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

Geologic Log and Well Construction Well 3

Cowlitz
Borehole Infiltration
JE1507

PGG

Depth (ft)	Graphic Log	Geologic Unit	Description	Test Zone	Well Construction



Depth (ft): 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136, 138, 140, 142, 144, 146, 148, 150, 152, 154, 156, 158, 160, 162, 164, 166, 168, 170, 172, 174, 176, 178, 180, 182, 184

Geologic Unit: UTA

Cemented, silty, SAND and GRAVEL. (hard drilling)

Loose, light brown, silty SAND and GRAVEL.

Dense, light brown, silty, sandy, GRAVEL. (cementation observed)

Light brown, silty, sandy, GRAVEL. (hard drilling)

Light brown, gravelly, SAND. (cobble made hard drilling)

Light brown, silty, sandy, GRAVEL. (hard drilling)

Geologic Unit: SGA

Loose,very silty, fine to coarse SAND.

Loose, light brown to gray, fine sandy, SILT. (trace clay)

Loose, silty, SAND. (observed coherent layers of clay and silt in discharge)

Loose, light brown, fine SAND and SILT. (sporadic gravel)

Dense, SAND and SILT.

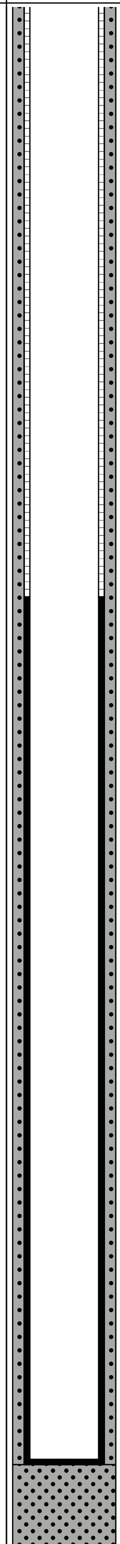
Loose, light brown, very silty, fine SAND.

Light brown, silty, sandy, GRAVEL. (sporadic clasts of compacted silty clay)

light brown, clayey, SILT. (sporadic clasts of compacted silty clay)

SILT, SAND, GRAVEL. (siltbound gravel, cementation observed)

Light brown, SAND and SILT.



125-ft to 175-ft schedule 80 PVC tail pipe

174-ft to 175-ft perforated schedule 80 PVC tail pipe with 1/16-in holes and slotted bottom

175-ft bottom of well

175-ft to 180-ft 4x8 sand backfill

180-ft bottom of boring

City, State: La Center, WA
Drilling Firm: Hansen/Tacoma Drilling
Drilling Method: Dual Rotary (AIR/WATER)
Date: 11/11/2016
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

Geologic Log and Well Construction Well 3

Cowlitz
Borehole Infiltration
JE1507

PGG

Depth (ft)	Geologic Unit	Description	Test Zone	Well Construction
-2				
0				
2		Red to brown, CLAY and SILT. (obtained from drillers log)		
4				
6				
8				
10				0-ft to 20-ft Bentonite surface seal
12				
14				
16				
18				
20				
22				
24				0-ft to 70-ft 12-in schedule 80 PVC riser pipe
26				
28				
30				
32	PAD			
34				
36				0-ft to 70-ft 16-in steel casing
38				
40				
42				
44				
46				
48				
50				
52				
54				
56		Light gray, CLAY. (obtained from drillers log)		
58				
60		Dense, brown, CLAY. (obtained from drillers log)		
62				
64				
66		Light brown to brown, slightly silty, sandy, GRAVEL. (sporadic cobbles)		
68				
70				70-ft bottom of 16-in casing
72				69-ft to 72-ft video log shows slight staining on well screen
74				
76		Light brown, silty, fine to coarse SAND and GRAVEL.		
78				74-ft to 78-ft video log shows slight staining on well screen
80		oxidized at 80-ft BGS		
82		cemented medium to coarse sand 83-ft BGS		
84				
86				
88		cemented at 90-ft BGS		
90				

City, State: La Center, WA
Drilling Firm: Hansen/Tacoma Drilling
Drilling Method: Dual Rotary (AIR)
Date: 12/13/2016
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

Geologic Log and Well Construction Well 4

Cowlitz
Borehole Infiltration
JE1507

PGG

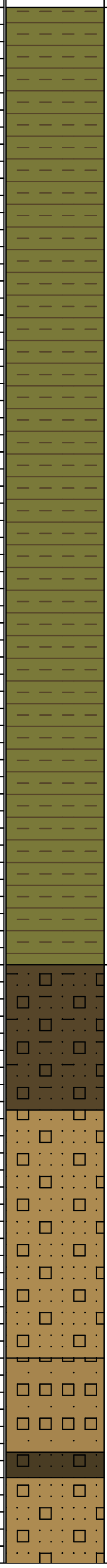
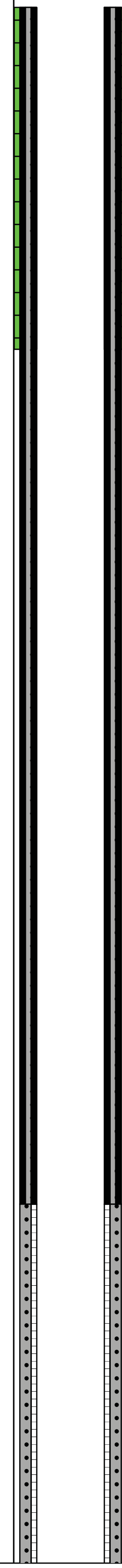
Depth (ft)	Geologic Unit	Description	Test Zone	Well Construction
92				
94				
96		Loose, brown, slightly silty, fine SAND. (oxidized)		70-ft to 165-ft schedule 80 slotted PVC screen (80 slot)
98				
100				
102				
104	UTA	Cemented, light brown to gray, slightly silty, fine to coarse sandy, GRAVEL.		
106				
108				
110		Light brown to gray, very slightly silty, fine to coarse sandy, GRAVEL.		
112				
114				
116		Light brown, medium to coarse SAND and GRAVEL.		
118		Cemented, light brown, medium to coarse SAND and GRAVEL.		
120				0-ft to 180-ft 4x8 sand pack
122				
124				
126				
128				
130				
132		Cemented, light brown to gray, sandy, GRAVEL. (sporadic cobbles)		
134				
136				
138				
140				
142				
144		Light brown, fine to medium SAND. (oxidized)		
146				
148				
150				
152		Light brown, fine SAND. 6-inch zone of cemented gravels at 152-ft BGS		
154				
156				156-ft to 158-ft video log shows slight staining on well screen
158				
160				
162	SGA	Brown, fine to medium SAND. (sporadic gravel)		
164				
166		Light brown, fine SAND. (hard drilling)		165-ft to 175-ft schedule 80 PVC tail pipe
168				
170				
172		Light brown to brown, fine to medium SAND. (sporadic gravel)		174-ft to 175-ft perforated schedule 80 PVC tail pipe with 1/16-in holes and slotted bottom
174				
176		Light brown, fine SAND.		175-ft bottom of well, 175-ft to 180-ft 4x8 sand backfill
178				
180				180-ft bottom of boring, drill shoe cut and left at bottom of the hole
182				
184				

City, State: La Center, WA
Drilling Firm: Hansen/Tacoma Drilling
Drilling Method: Dual Rotary (AIR)
Date: 12/13/2016
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

Geologic Log and Well Construction
Well 4

Cowlitz
Borehole Infiltration
JE1507

PGG

Depth (ft)	Graphic Log	Geologic Unit	Description	Test Zone	Well Construction
0–56		PAD	Red to brown, CLAY and SILT. (obtained from drillers log)		
56–64		UTA	Light brown, very silty, fine sandy, GRAVEL to SAND and GRAVEL.		
64–80		UTA	Loose, slightly silty, medium to coarse SAND and GRAVEL. cemented zone at 68-ft BGS small zone of finer material from 70-ft to 71-ft BGS		
80–85		UTA	Light brown, fine to coarse sandy, GRAVEL. (oxidized)		
85–90		UTA	Cemented, light brown, slightly silty, fine to coarse sandy, GRAVEL.		

Depth scale: -2 to 90 ft.

Well Construction

0-ft to 20-ft Bentonite surface seal

0-ft to 70-ft 12-in schedule 80 PVC riser pipe

0-ft to 70-ft 16-in steel casing

0-ft to 174-ft 4x8 sand pack

70-ft bottom of 16-in casing

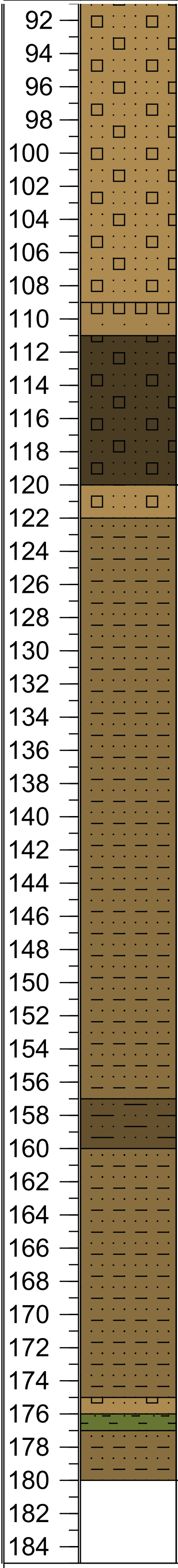
City, State: La Center, WA
Drilling Firm: Hansen/Tacoma Drilling
Drilling Method: Dual Rotary (AIR)
Date: 11/21/2016
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

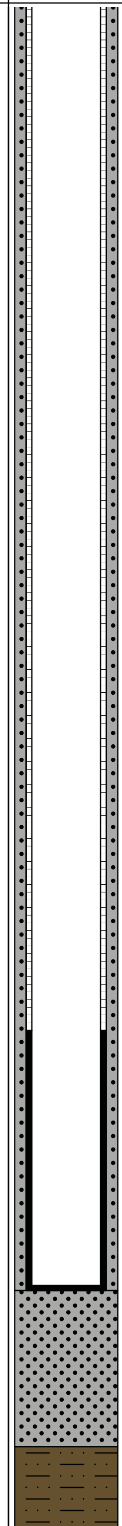
Geologic Log and Well Construction Well 5

Cowlitz
Borehole Infiltration
JE1507

PGG

Depth (ft)	Graphic Log	Geologic Unit	Description	Test Zone	Well Construction
92–110			Light brown to brown, silty, fine to medium very sandy, GRAVEL. harder drilling at 89-ft BGS increased fine to medium sand at 90-ft BGS easier drilling formation taking air at 95-ft BGS cemented at 97-ft BGS looser at 106-ft		70-ft to 150-ft schedule 80 slotted PVC screen (80 slot)
110–112			Slightly silty, slightly sandy, GRAVEL. (formation is taking air)		
112–120			Light brown to gray, silty, SAND and GRAVEL. (formation is taking air, sporadic cemented layers)		
120–122		SGA	Light brown, gravelly, fine to medium SAND. (oxidized)		
122–157			Light brown fine to medium SAND. (sporadic gravel, oxidized) loose at 140-ft BGS trace silt 140-ft to 157-ft BGS harder drilling starting at 148-ft BGS		150-ft to 165-ft schedule 80 PVC tail pipe
157–160			Light brown, slightly silty, fine SAND.		164-ft to 165-ft perforated schedule 80 PVC tail pipe with 1/16-in holes and slotted bottom 165-ft bottom of well
160–175			Light brown, fine to medium SAND. bore hole staying open from 160-ft to 173-ft BGS small zone of gravel at 170-ft BGS		165-ft to 174-ft 4x8 sand backfill, 174-ft to 179-ft natural fill hole collapsed
175–176			Light brown, gravelly, fine to medium SAND.		
176–177			Dense, SILT and CLAY.		179-ft bottom of boring, drill shoe cut and left at bottom of the hole
177–180			Loose, light brown, fine to medium SAND.		





City, State: La Center, WA
Drilling Firm: Hansen/Tacoma Drilling
Drilling Method: Dual Rotary (AIR)
Date: 11/21/2016
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

Geologic Log and Well Construction Well 5

Cowlitz
Borehole Infiltration
JE1507

PGG

Depth (ft)	Graphic Log	Geologic Unit	Description	Test Zone	Well Construction
-2 to 0					
0 to 57		PAD	Red to brown, CLAY and SILT. (obtained from drillers log)		0-ft to 20-ft Bentonite surface seal 0-ft to 70-ft 12-in schedule 80 PVC riser pipe 0-ft to 70-ft 16-in steel casing
57 to 65		UTA	Cemented, light brown, slightly silty, medium to coarse sandy, GRAVEL.		
65 to 70		UTA	Cemented, light brown, very silty, fine to coarse sandy, GRAVEL.		
70 to 80		UTA	Loose, light brown, very silty, fine to coarse sandy, GRAVEL. oxidized at 75-ft BGS		70-ft bottom of 16-in casing
80 to 90		UTA	Light brown to brown, fine to medium sandy, GRAVEL.		70-ft to 130-ft schedule 80 slotted PVC screen (80 slot)

City, State: La Center, WA
Drilling Firm: Hansen/Tacoma Drilling
Drilling Method: Dual Rotary (AIR)
Date: 12/7/2016
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

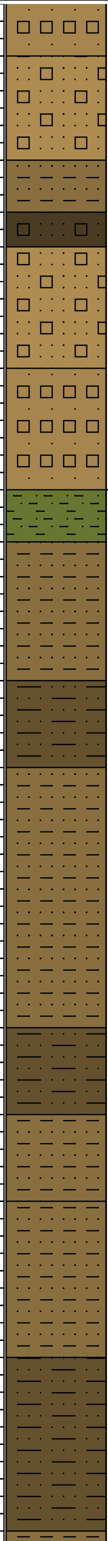
Geologic Log and Well Construction
Well 6

Cowlitz
Borehole Infiltration
JE1507

PGG

Depth (ft)	Graphic Log	Geologic Unit	Description	Test Zone	Well Construction

Depth (ft): 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136, 138, 140, 142, 144, 146, 148, 150, 152, 154, 156, 158, 160, 162, 164, 166, 168, 170, 172, 174, 176, 178, 180, 182, 184



Geologic Unit: SGA

Description

Loose, light brown, medium to coarse sandy, GRAVEL.

Brown, slightly silty, fine to medium SAND and GRAVEL. (oxidized, cemented at 97-ft BGS)

Brown, slightly silty, fine to medium SAND. (sporadic gravel, oxidized)

Cemented, coarse sandy, GRAVEL.

Gray, slightly silty, fine to coarse SAND and GRAVEL.

Light brown, slightly silty, fine to medium sandy, GRAVEL. (thin zone of silt and fine sand at 112-ft BGS)

Light brown, SAND and SILT. (sporadic gravel)

Loose, light brown, fine to medium SAND.

Brown, silty, fine SAND. (oxidized, borehole is staying open without casing from 130-ft to 180-ft BGS)

Light brown, fine SAND.

Light brown, silty, fine SAND.

Brown, fine to medium SAND. (oxidized)

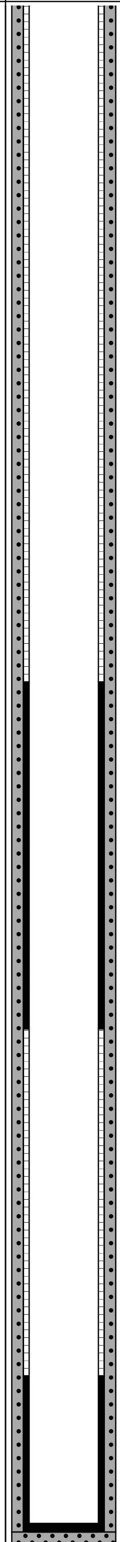
Light brown, medium SAND.

Light brown, silty, fine SAND.

compacted fine SAND and SILT layers observed at 175-ft BGS

Light brown, medium SAND.

Well Construction



0-ft to 180-ft 4x8 sand pack

130-ft to 150-ft 12-in schedule 80 PVC riser pipe

150-ft to 170-ft schedule 80 slotted PVC screen (80 slot)

170-ft to 179-ft schedule 80 PVC tail pipe

178-ft to 179-ft perforated schedule 80 PVC tail pipe with 1/16-in holes and slotted bottom

179-ft bottom of well, 179-ft to 180-ft 4x8 sand backfill

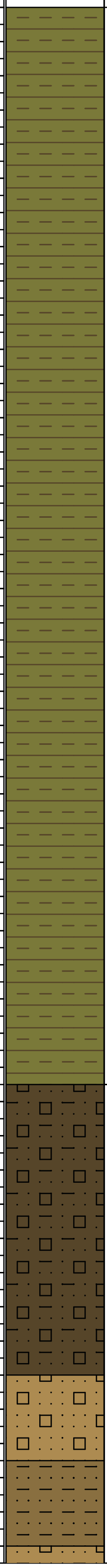
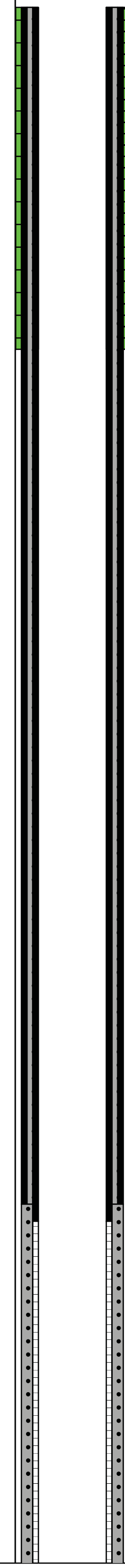
180-ft bottom of boring, drill shoe cut and left at bottom of the hole

City, State: La Center, WA
Drilling Firm: Hansen/Tacoma Drilling
Drilling Method: Dual Rotary (AIR)
Date: 12/7/2016
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

Geologic Log and Well Construction Well 6

Cowlitz
Borehole Infiltration
JE1507

PGG

Depth (ft)	Graphic Log	Geologic Unit	Description	Test Zone	Well Construction
0–63		PAD	Red to brown, CLAY and SILT. (obtained from drillers log)		 0-ft to 20-ft Bentonite surface seal; 0-ft to 74-ft 12-in schedule 80 PVC riser pipe; 0-ft to 70-ft 16-in steel casing
63–80			Light brown to brown, slightly silty, coarse sandy, GRAVEL.		70-ft bottom of 16-in casing; 72-ft to 120-ft video log shows staining on well screen
80–85			Light brown, fine to coarse SAND and GRAVEL. (oxidized) Cemented medium to coarse sand 83-ft BGS		
85–90			Light brown, fine to coarse SAND. (sporadic gravel)		

City, State: La Center, WA
Drilling Firm: Hansen/Tacoma Drilling
Drilling Method: Dual Rotary (AIR)
Date: 12/20/2016
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

Geologic Log and Well Construction Well 7

Cowlitz
Borehole Infiltration
JE1507

PGG

Depth (ft)	Graphic Log	Geologic Unit	Description	Test Zone	Well Construction
		UTA	Light brown, fine to coarse sandy, GRAVEL.		
		UTA	Cemented, light brown, fine to coarse sandy, GRAVEL.		
		UTA	Loose, light brown, fine to medium sandy, GRAVEL.		
		UTA	Cemented, light brown, medium to coarse SAND and GRAVEL. (sporadic cobbles)		
		UTA	Cemented, light gray to gray, fine to medium sandy, GRAVEL.		
		UTA	Light brown to gray, fine to coarse very sandy, GRAVEL.		
		UTA	Loose, light brown to gray, fine to coarse sandy, GRAVEL.		
		SGA	Light brown, slightly silty, fine SAND.		
		SGA	Light brown, fine to medium SAND. (sporadic gravel)		
		SGA	Light brown to brown, gravelly, fine to medium SAND. (oxidized)		
			Light brown, fine SAND.		

Depth (ft): 92, 94, 96, 98, 100, 102, 104, 106, 108, 110, 112, 114, 116, 118, 120, 122, 124, 126, 128, 130, 132, 134, 136, 138, 140, 142, 144, 146, 148, 150, 152, 154, 156, 158, 160, 162, 164, 166, 168, 170, 172, 174, 176, 178, 180, 182, 184

Well Construction:

71-ft to 166-ft schedule 80 slotted PVC screen (80 slot)

0-ft to 135-ft 1/4x1/8 sand pack
135-ft to 180-ft 4x8 sand pack

120-ft to 170-ft video log shows slight staining on well screen, appears washed from infiltration test

178-ft video log shows sediment in bottom of the tail pipe

166-ft to 176-ft schedule 80 PVC tail pipe

175-ft to 176-ft perforated schedule 80 PVC tail pipe with 1/16-in holes and slotted bottom

176-ft bottom of well, 176-ft to 180-ft 4x8 sand backfill

180-ft bottom of boring, drill shoe cut and left at bottom of the hole

City, State: La Center, WA
Drilling Firm: Hansen/Tacoma Drilling
Drilling Method: Dual Rotary (AIR)
Date: 12/20/2016
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

Geologic Log and Well Construction Well 7

Cowlitz
Borehole Infiltration
JE1507

PgG

PACIFIC groundwater GROUP

Technical Memorandum

To: Mike Ollivant, Parametrix

From: Pony Ellingson and Travis Klaas (Pacific Groundwater Group)

Re: Summary of Monitoring Well Installation, Cowlitz Reservation

Date: 4/17/2017

This memo describes the construction and completion of monitoring wells MW-1 and MW-2, for the Cowlitz Tribe in conjunction with the borehole infiltration activities at the Cowlitz Casino.

MONITORING WELLS

These wells will be used for monitoring the groundwater quality downgradient of the reclaimed water infiltration wells. Pacific Groundwater Group (PGG) was present to observe much (but not all) drilling activities and assist with final well design. PGG coordinated with Hansen Drilling to complete the installation and develop the wells. The two monitoring wells were installed between March 28th and April 6th, 2017.

MW-1 CONSTRUCTION

MW-1 was drilled and constructed within the targeted hydrogeologic zone between March 28th and March 31st, 2017. It was drilled to a depth of 316 feet below ground surface (BGS) and completed with 6-inch diameter casing, K-packer, 5-inch riser pipe, 5-inch stainless steel screen with a tail pipe and bail bottom, as follows (also see attached well log):

- Casing 0-ft to 291.2-ft
- K packer 289.3-ft
- Riser pipe 289.3-ft to 293-ft
- Screen 293-ft to 303-ft
- Tail pipe with bail bottom 303-ft to 306-ft
- Backfill 306-ft to 316-ft

Hansen Drilling developed MW-1 on April 3, 2017. Development and initial testing yielded a static water level of 230.9 feet BGS, visually clear water at roughly 20 gallons per minute (GPM), with seven feet of drawdown after two hours.

MW-2 WELL CONSTRUCTION

MW-2 was drilled and constructed between April 1st and April 6th, 2017. It was completed across the first two sandy zones encountered below the water table, which comprised the shallowest viable well completion zone based on field observations. It was drilled to a depth of 296 feet (BGS) and completed with 6-inch diameter casing, K-packer, 5-inch riser pipe, 5-inch stainless steel screen with a tail pipe and bail bottom, as follows (also see attached well log):

- Casing 0-ft to 265.5-ft
- K packer 261.7-ft
- Riser pipe 261.7-ft to 265-ft
- Screen 265-ft to 270-ft
- Riser pipe 270-ft to 280-ft
- Screen 280-ft to 285-ft
- Tail pipe with bail bottom 285-ft to 288-ft
- Backfill 288-ft to 296-ft

Hansen Drilling developed MW-2 on April 5, 2017. Development and initial testing yielded a static water level of 236 feet BGS, visually clear water at roughly 20 GPM, with 8.5 feet of drawdown after two hours.

REPORT WARRANTY

PGG's work was performed, and this report prepared, using generally accepted hydrogeologic practices used at this time and in this vicinity, for exclusive application to the monitoring well installation project and for the exclusive use of Parametrix and the Cowlitz Tribe. This is in lieu of other warranties, express or implied.

Attachments:

1. Geologic Log and Well Construction MW-1 (PGG)
2. Hansen Drilling MW-1 Well Log and Test Data
3. Geologic Log and Well Construction MW-2 (PGG)
4. Hansen Drilling MW-2 Well Log and Test Data

Depth (ft)	Graphic Log	Geologic Unit	Description	Test Zone	Well Construction
0		PAD	Top soil and FILL. (obtained from drillers log)		0-ft to 18-ft Bentonite surface seal
			Brown, silty, CLAY. (obtained from drillers log)		
30			Wet, brown, SILT. (obtained from drillers log)		
40			Moist, light brown to light gray, slightly silty, CLAY. (trace sand 50-ft to 62-ft)		
62			Moist, light brown, silty, SAND and GRAVEL. (cemented drill action)		
68			Moist, light brown, slightly sandy, silty, GRAVEL.		
			Moist, light brown, SILT, SAND and GRAVEL.		
			Moist, slightly sandy, silty, GRAVEL.		

Depth scale: -2, 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78

City, State: La Center, WA
Drilling Firm: Hansen Drilling/Mark Blackburn
Drilling Method: Air Rotary
Date: 3/28/2017
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

Unique Well ID: BJN 666
Depth to Water: 230-ft BGS

Geologic Log and Well Construction MW-1

Cowlitz
Borehole Infiltration
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PgG

Depth (ft)	Graphic Log	Geologic Unit	Description	Test Zone	Well Construction
78–80		UTA	Moist, light brown to brown, SILT, SAND and GRAVEL.		0-ft to 291.2-ft 6-in steel casing
80–85			Moist, light brown, slightly sandy, slightly silty, GRAVEL.		
86–88			Moist, light brown, SILT, SAND and GRAVEL.		
88–92			Moist, light brown, slightly silty, slightly sandy, GRAVEL.		
92–98			Moist, light brown, SILT, SAND and GRAVEL.		
98–103			Moist, light brown, slightly silty, slightly sandy, GRAVEL.		
103–106			Moist, light brown, SILT, SAND and GRAVEL.		
106–109			Moist, light brown, silty, sandy, GRAVEL.		
109–112			Moist, light brown, SILT, SAND and GRAVEL.		
112–116			Moist, light brown, slightly silty, slightly sandy, GRAVEL.		
116–120			Moist, light brown, slightly silty, fine to coarse sandy, GRAVEL.		
120–123			Moist, light brown, SILT, SAND and GRAVEL.		
123–127			Moist, light brown, slightly silty, slightly sandy, GRAVEL.		
127–130			Moist, light brown, silty, sandy, GRAVEL.		
130–134			Moist, light brown to light gray, very silty, fine to medium SAND.		
134–137			Moist, light brown, fine to medium SAND and SILT.		
137–150			Moist, light brown, very slightly silty, fine to medium SAND.		
150–155			Moist, light brown, slightly silty, fine to medium SAND. (trace gravel)		
155–158			Moist, light brown, gravelly, silty, fine to medium SAND.		

City, State: La Center, WA
Drilling Firm: Hansen Drilling/Mark Blackburn
Drilling Method: Air Rotary
Date: 3/28/2017
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

Unique Well ID: BJN 666
Depth to Water: 230-ft BGS

Geologic Log and Well Construction MW-1

Cowlitz
Borehole Infiltration
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PGG

Depth (ft)	Graphic Log	Geologic Unit	Description	Test Zone	Well Construction
158					
160			Moist, light brown, slightly silty, fine to medium SAND. (sporadic gravels, mica observed)		
170			Moist, light brown, medium to coarse SAND. (sporadic gravel)		
176			Moist, light brown, fine to medium SAND. (sporadic gravel)		
182			Moist, light brown, silty, fine to coarse, SAND. (thin layers of tan to off white cemented sand)		
186			Moist, light brown, very slightly silty, gravelly, medium to coarse SAND.		
190			Moist, light brown, silty, SAND.		
192			Moist, light brown, sandy, GRAVEL.		
196			Moist, brown, very silty, fine to medium SAND. (sporadic gravel, cementation observed)		
202			Moist, brown, fine to medium SAND and SILT. (interbedded layers of sand and silt 194-ft to 196-ft)		
206			Moist, light brown to brown, silty, fine to medium SAND.		
210			Moist, light brown, fine to medium SAND and SILT. (driller notes cemented drill action)		
222		SGA	Moist, light brown, fine sandy, SILT. (cementation observed, sporadic gravel, trace clay)		
230					Static water level 230.9-ft BGS (4/3/2017)
238			Moist, light brown to brown, very silty, fine to medium		

Depth markers: 158, 160, 162, 164, 166, 168, 170, 172, 174, 176, 178, 180, 182, 184, 186, 188, 190, 192, 194, 196, 198, 200, 202, 204, 206, 208, 210, 212, 214, 216, 218, 220, 222, 224, 226, 228, 230, 232, 234, 236, 238

City, State: La Center, WA
Drilling Firm: Hansen Drilling/Mark Blackburn
Drilling Method: Air Rotary
Date: 3/28/2017
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

Unique Well ID: BJN 666
Depth to Water: 230-ft BGS

Geologic Log and Well Construction
MW-1

Cowlitz
Borehole Infiltration
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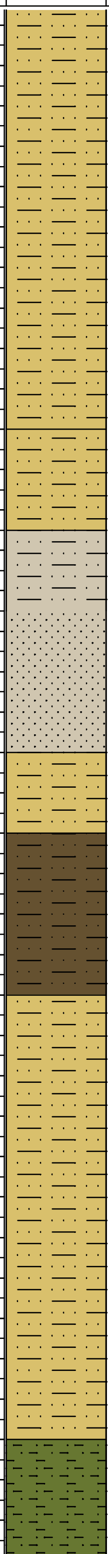
PGG

Depth (ft)	Graphic Log	Geologic Unit	Description	Test Zone	Well Construction

Depth (ft): 240, 242, 244, 246, 248, 250, 252, 254, 256, 258, 260, 262, 264, 266, 268, 270, 272, 274, 276, 278, 280, 282, 284, 286, 288, 290, 292, 294, 296, 298, 300, 302, 304, 306, 308, 310, 312, 314, 316, 318, 320



Description

SAND. (cemented sand clasts, driller notes drilling is difficult)

Moist to wet, light brown, very silty, fine SAND. (sporadic silt clasts)

Moist to wet, light gray to light brown, silty, fine SAND.

Wet, light gray to light brown, slightly silty, fine to medium SAND. (sporadic gravel)

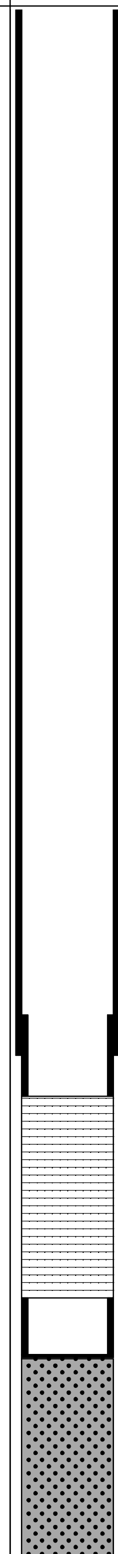
Wet, light brown to brown, silty, fine to medium SAND.

Moist to wet, light brown, fine to medium SAND and SILT.

Wet, light brown to brown, silty, fine to coarse SAND. (sporadic gravel, oxidized, mica observed, cementation observed)

Moist, brown, fine sandy, SILT. (sporadic gravel)

Well Construction



289.3-ft K packer

289.3-ft to 293-ft 5-in steel riser pipe

293-ft to 303-ft 5-in stainless steel slotted screen (12 slot)

303-ft to 306-ft 5-in steel tail pipe with bail bottom

306-ft bottom of well

306-ft to 316-ft chlorinated pea gravel backfill

316-ft bottom of boring

City, State: La Center, WA
Drilling Firm: Hansen Drilling/Mark Blackburn
Drilling Method: Air Rotary
Date: 3/28/2017
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

Unique Well ID: BJN 666
Depth to Water: 230-ft BGS

Geologic Log and Well Construction MW-1

Cowlitz
Borehole Infiltration
JE1507

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Construction/Decommission *("x" in circle)*

XX Construction

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ______

CURRENT
Notice of Intent No. ______

Unique Ecology Well ID Tag No. BJN 666

Water Right Permit No. ______

Property Owner Name Cowlits Tribe North well

Well Street Address NW 319th St. & Pekin Ferry Rd

City Ridgefield County Clark

Location SW 1/4-1/4 SE 1/4 Sec 5 Twn 4N R 1E EWM or WWM (circle one)

Lat/Long (s, t, r Still REQUIRED) Lat Deg ______ Lat Min/Sec ______ Long Deg ______ Long Min/Sec ______

Tax Parcel No. ______

PROPOSED USE: ☐ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well XX Other Monitoring

TYPE OF WORK: Owner's number of well (if more than one) ______

☐ New well ☐ Reconditioned ☐ Deepened *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Cable XX Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 316 ft.
Depth of completed well 306 ft.

CONSTRUCTION DETAILS

Casing Installed: XX Welded 6" Diam. from + 2 ft. to 291'2 ft.
☐ Liner installed 5" head Diam. from 289'4 ft. to 293 ft.
☐ Threaded Tail 5" Diam. from 303 ft. to 306 ft.

Perforations: ☐ Yes XX No

Type of perforator used ______

SIZE of perfs ______ in. by ______ in. and no. of perfs ______ from ______ ft. to ______ ft.

Screens: XX Yes ☐ No ☐ K-Pac Location 289'4

Manufacturer's Name Johnson

Type Stainless steel Model No. ______

Diam. 5" Slot size 12 from 293 ft. to 303 ft.

Diam. ______ Slot size ______ from ______ ft. to ______ ft.

Gravel/Filter packed: ☐ Yes XX No ☐ Size of gravel/sand ______

Materials placed from ______ ft. to ______ ft.

Surface Seal: XX Yes ☐ No To what depth? 18 ft.

Material used in seal 3/4" Bentonite

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? ______ Depth of strata ______

Method of sealing strata off ______

PUMP: Manufacturer's Name ______

Type: ______ H.P. ______

WATER LEVELS: Land-surface elevation above mean sea level ______ ft.

Static level 232'11" ft. below top of well Date 4-3-17

Artesian pressure ______ lbs. per square inch Date ______

Artesian water is controlled by ______ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☒ Yes ☐ No If yes, by whom? Blackburn

Yield: 20 gal./min. with 7 ft. drawdown after 2 hrs.

Yield: ______ gal./min. with ______ ft. drawdown after ______ hrs.

Yield: ______ gal./min. with ______ ft. drawdown after ______ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
5 mins	232'11				

Date of test 4-3-17

Bailer test 15 gal./min. with 4 ft. drawdown after 2 hrs.

Airtest 20 gal./min. with stem set at 300 ft. for 1/2 hrs.

Artesian flow ______ g.p.m. Date ______

Temperature of water 53° Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Top soil & Fill	0	1
Brown silty clay	1	30
Brown wet silt	30	40
Brown silt & clay	40	61
Brown silt sand & gravel	61	125
Dark brown silt & sand	125	132
Brown silty sandstone	132	245
Cemented sandstone, brown with scattered gravel	245	270
Brown sand & water	270	275
Brown silty sand scattered gravel	275	289
Brown cemented sand & water	289	305
Cemented sandstone	305	315

Start Date 3-28-17 Completed Date 3-31-17

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

XX Driller ☐ Engineer ☐ Trainee Name (Print) Mark Blackburn

Driller/Engineer/Trainee Signature [signature]

Driller or trainee License No. 2296

If TRAINEE, Driller's Licensed No. ______

Driller's Signature ______

Drilling Company Hansen Drilling Co. Inc

Address 6711 nE 58th Ave.

City, State, Zip Vancovuer, Wa 98661

Contractor's Registration No. HANSEDC947RJ Date 4-7-17

Ecology is an Equal Opportunity Employer.

The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.

"Helping to Protect Your Ground Water Since 1918"

Email: peggyj@hansendrilling.com

HANSEN DRILLING CO., INC.

6711 N.E. 58th Avenue
Vancouver, WA 98661-1499
(360) 694-6242 Fax (360) 737-3766
1 (888) 694-6240

HANSEDC947RJ

Member of NGWA, WSDGWA
OGWA, BIAW

Date: 4-3-17

Name: Swinerton Builders North Well Phone: ____
Mailing Address: ____ Cell: ____
Job Location: Cowlitz Casino Monitoring well Fax: ____
Depth: ____ Static Water Level: 232'-11" Email: ____
2 Hour Flow Test Water Samples; Coliform Bacteria ____ Nitrate ____ & Arsenic ____
Well Log YES____ NO ____ Well ID Tag: BJN-666 Well Size: 6"

Time	Pumping Level	GPM	Temperature	WATER CONDITION & COMMENTS Sand, Color, Rust Flakes, Etc…
9:30	232'11"	12	53°	Cloudy
9:45	235'1"	" "	53°	" "
10:00	237'4"	" "	53°	" "
10:15	237'1"	" "	53°	Clear w/ air
10:30	237'1"	" "	53°	Clear
10:30	239'10"	20	53°	Cloudy
10:45	239'10"	" "	53°	Clear
11:00	" "	" "	53°	" "
11:15	" "	" "	53°	" "
11:30	" "	" "	53°	" "

Time	Recovery
1 min.	234-9
2 min.	233-3
3 min.	233-1
5 min.	232-11
FULL RECOVERY	

Licensed Driller: ____
Drillers' Lic. #: ____

Well Casing Above Grade: ____ (6" min. code) Below Grade: ____
Well Curb: ____ Pitless Adapter: ____ Pump House: ____ Reservoir: ____
Pump System Overall Condition Visual: Good: ____ Poor: ____

Comments: ____

Depth (ft)	Graphic Log	Geologic Unit	Description	Test Zone	Well Construction
0		PAD	Moist to wet, light brown, clayey, sandy, SILT. (fill)		0-ft to 18-ft Bentonite surface seal
			Moist to wet, light gray, silty, sandy, GRAVEL. (fill)		
			Moist, light brown, clayey, sandy, SILT. (sporadic gravel, oxidized)		
10			Moist, light brown, clayey, SILT to CLAY and SILT. (sporadic sand)		
30			Moist, light brown to light gray, CLAY and SILT.		
40			Moist, light brown, clayey, SILT.		
50			Moist, light brown to light gray, CLAY and SILT.		
57			Moist, light brown, gravelly, clayey, SILT.		
70			Moist, light brown, clayey, silty, sandy, GRAVEL.		

Depth scale: -2, 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72

City, State: La Center, WA
Drilling Firm: Hansen Drilling/Mark Blackburn
Drilling Method: Air Rotary
Date: 4/1/2017
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

Unique Well ID: BJN 667
Depth to Water: 236-ft BGS

Geologic Log and Well Construction MW-2

Cowlitz
Borehole Infiltration
JE1507

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Depth (ft)	Graphic Log	Geologic Unit	Description	Test Zone	Well Construction
74 76 78		UTA			0-ft to 265.3-ft 6-in steel casing
80 82 84 86 88 90 92 94 96 98			Moist, light brown, slightly silty, slightly sandy, GRAVEL. Silt decreasing with depth, sand coarsening with depth		
100 102 104 106 108			Moist, light brown to brown, very silty, fine to coarse SAND. (sporadic gravel)		
110 112 114 116 118			Moist, light brown to brown, very slightly silty, very slightly fine sandy, GRAVEL. (cemented drill action)		
120 122 124 126 128			Moist, light brown, very slightly silty, fine to coarse sandy, GRAVEL. (cemented drill action)		
130 132 134 136 138			Moist, light brown, slightly gravelly, very silty, fine SAND. (cemented drill action)		
140 142 144 146 148			Moist, light brown, slightly silty, fine to medium SAND. (sporadic gravel)		

City, State: La Center, WA
Drilling Firm: Hansen Drilling/Mark Blackburn
Drilling Method: Air Rotary
Date: 4/1/2017
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

Unique Well ID: BJN 667
Depth to Water: 236-ft BGS

Geologic Log and Well Construction MW-2

Cowlitz
Borehole Infiltration
JE1507

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Depth (ft)	Graphic Log	Geologic Unit	Description	Test Zone	Well Construction

Depth (ft): 148, 150, 152, 154, 156, 158, 160, 162, 164, 166, 168, 170, 172, 174, 176, 178, 180, 182, 184, 186, 188, 190, 192, 194, 196, 198, 200, 202, 204, 206, 208, 210, 212, 214, 216, 218, 220, 222, 224

Geologic Unit: SGA

Description:

Moist, light brown, silty, fine to medium SAND.

Moist, light brown to brown, slightly silty, fine to coarse sandy, GRAVEL.

Moist, light brown, medium to coarse SAND. (clean)

Moist, light brown, very slightly silty, medium SAND. (loose)

Moist, light brown, silty, fine to medium SAND.

Moist, light brown, medium to coarse SAND. (clean, sporadic gravel)

Moist, light brown, medium SAND. (oxidized)

Moist, light brown, silty, fine to medium SAND. (oxidized)

Moist, light brown, slightly silty, fine to medium SAND. (decreasing silt with depth)

Moist, light brown, SAND and SILT.

Moist, light brown, fine sandy, SILT. (sporadic gravel)

Moist, light brown to brown, fine SAND and SILT. (sporadic gravel, cemented sandstone clasts)

City, State: La Center, WA
Drilling Firm: Hansen Drilling/Mark Blackburn
Drilling Method: Air Rotary
Date: 4/1/2017
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

Unique Well ID: BJN 667
Depth to Water: 236-ft BGS

Geologic Log and Well Construction MW-2

Cowlitz
Borehole Infiltration
JE1507

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Depth (ft)	Graphic Log	Geologic Unit	Description	Test Zone	Well Construction

Depth scale: 224–300 ft

Description

Moist, light brown, very silty, fine to medium SAND. (sporadic gravel, cementation observed)

Moist, light brown, SAND and SILT.

Moist, light brown, silty, fine SAND.

Moist, light gray, very fine SAND and SILT. (trace gravel)

Water observed at 255-ft, minimal water present at time of drilling

Wet, light brown to light gray, silty, fine SAND. (mica observed)

Moist, light brown, fine to medium SAND.

Wet, light brown, very slightly silty, fine SAND. (mica observed)

small zone of black gravel 276-ft

Oxidized 277-ft to 279-ft
Increased water 278-ft

Red oxidized sandstone clasts 284-ft

Well Construction

Static water level 236-ft BGS (4/5/17)

261.7-ft K packer

261.7-ft to 265-ft 5-in steel riser pipe

265-ft to 270-ft 5-in stainless steel slotted screen (10 slot)

270-ft to 280-ft 5-in riser pipe

280-ft to 285-ft 5-in stainless steel slotted screen (10 slot)

285-ft to 288-ft 5-in steel tail pipe with bail bottom

288-ft bottom of well

288-ft to 296-ft chlorinated pea gravel backfill

296-ft bottom of boring

City, State: La Center, WA
Drilling Firm: Hansen Drilling/Mark Blackburn
Drilling Method: Air Rotary
Date: 4/1/2017
MP Elevation: Ground surface ATD
Consulting Firm: Pacific Groundwater Group
Logged by: Travis Klaas

Unique Well ID: BJN 667
Depth to Water: 236-ft BGS

Geologic Log and Well Construction MW-2

Cowlitz
Borehole Infiltration
JE1507

PGG

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

ECOLOGY

Construction/Decommission *("x" in circle)*

(X) Construction

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ______

CURRENT
Notice of Intent No. ______

Unique Ecology Well ID Tag No. BJN 667

Water Right Permit No. ______

Property Owner Name Cowlitz Tribe South well

Well Street Address NW 319th St & S Pekins Freey Rd

City Ridgefield County Clark

Location SW 1/4-1/4 SE 1/4 Sec 5 Twn 4N R 1E EWM or WWM (circle one)

Lat/Long (s, t, r Still REQUIRED) Lat Deg ______ Lat Min/Sec ______ Long Deg ______ Long Min/Sec ______

Tax Parcel No. ______

PROPOSED USE: ☐ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☒ Other Momitoring

TYPE OF WORK: Owner's number of well (if more than one) ______

☒ New well ☐ Reconditioned ☐ Deepened *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled ______ ft.
Depth of completed well ______ ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 6" " Diam. from + 2' ft. to 265'3 ft.
☐ Liner installed Head 5" Diam. from 261'8 ft. to 265 ft.
☐ Threaded Tail 5" " Diam. from 285 ft. to 288 ft.

Perforations: ☐ Yes ☒ No 5" Head pipe 270 - 280

Type of perforator used ______

SIZE of perfs ______ in. by ______ in. and no. of perfs ______ from ______ ft. to ______ ft.

Screens: ☒ Yes ☐ No ☐ K-Pac Location 261'8"

Manufacturer's Name Johnson

Type stainless steel Model No. ______

Diam. 5 Slot size 10 from 265 ft. to 270 ft.

Diam. 5 Slot size 10 from 280 ft. to 285 ft.

Gravel/Filter packed: ☒ Yes ☐ No ☐ Size of gravel/sand ______

Materials placed from ______ ft. to ______ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft.

Material used in seal 3/4" Bentonite

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? ______ Depth of strata ______

Method of sealing strata off ______

PUMP: Manufacturer's Name ______
Type: ______ H.P. ______

WATER LEVELS: Land-surface elevation above mean sea level ______ ft.

Static level 238 ft. below top of well Date 4-5-17

Artesian pressure ______ lbs. per square inch Date ______

Artesian water is controlled by ______ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☒ Yes ☐ No If yes, by whom? Blackburn

Yield: 20 gal./min. with 9 ft. drawdown after 2 hrs.
Yield: ______ gal./min. with ______ ft. drawdown after ______ hrs.
Yield: ______ gal./min. with ______ ft. drawdown after ______ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
4 mins	238				

Date of test 4-5-16

Bailer test 10 gal./min. with 2 ft. drawdown after 2 hrs.

Airtest 10 gal./min. with stem set at 280 ft. for 1/2 hrs.

Artesian flow ______ g.p.m. Date ______

Temperature of water 53° Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Brown silt	0	2
Fill gravel	2	5
Brown silty clay	5	57
Brown silt & gravel	57	110
Dark brown cemented gravel	110	130
Brown sand, cemented	130	242
Brown sand & water	242	296

Start Date 4-1-17 Completed Date 4-6-17

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Mark Blackburn

Driller/Engineer/Trainee Signature [signature]

Driller or trainee License No. 2296

If TRAINEE, Driller's Licensed No. ______
Driller's Signature ______

Drilling Company Hansen Drilling Co. Inc

Address 6711 NE 58th Ave.

City, State, Zip Vancouver, Wa 98661

Contractor's Registration No. HANSEDC947RJ Date 4-7-17

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05)

The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.

"Helping to Protect
Your Ground
Water Since 1918"

HANSEN DRILLING CO., INC

6711 N.E. 58th Avenue
Vancouver, WA 98661-1499
(360) 694-6242 Fax (360) 737-3766
1 (888) 694-6240
Email: peggyj@hansendrilling.com

HANSEDC947RJ

Member of NGWA, WSDGWA
OGWA, BIAW

Date: 4-5-16

Name: Cowlits Tribe South Well

Phone: ______

Mailing Address: ______

Cell: ______

Job Location: NW 319 th St & PekinFerry Rd

Fax: ______

Depth: 288 Static Water Level: 238 Email: ______

2 Hour Flow Test Water Samples; Coliform Bacteria ______ Nitrate ______ & Arsenic ______

Well Log YES XX NO ____ Well ID Tag: BJN 667 Well Size: 6"

TIME	PUMPING LEVEL	GPM	TEMPERATURE	WATER CONDITION & COMMENTS Sand, Color, Rust Flakes, Etc.
2:00	241'	5	53°	clean
2:05	240'6"	5		clean
2:10	240'6"	5		clean
2:30	242'	10		clean
2:45	243'8:	15	53°	clear
3:00	246'6"	20		clean
3:15	246'7"	20		clean
3:30	246'7"	20	53°	clean
3:45	246'7	20		clean
4:00	246'7"	20	53°	clean

Licensed Driller: Mark Blackburn
Driller's Lic.: 2296

TIME	RECOVERY
4:01	240'
4:02	239'
4:03	238'6"
4:04	238

Well Casing Above Grade: 2' (6" minimum code) Below Grade: ______

Well Curb: ______ Pitless Adapter ______ Pump House ______ Reservoir: ______

Pump System Overall Condition Visual: Good: ______ Poor: ______

Comments: ______

Parametrix DATE: March 30, 2017 FILE: PS7367002F14-1

N

0 400
SCALE IN FEET

LEGEND

- INITIAL WELL INSTALLATIONS
- FUTURE WELL INSTALLATIONS
- WELL SPACING RADIUS

Figure 14-1
Monitoring Well Location Plan
Cowlitz Reservation Development

Appendix F

Lockout/Tagout Policy

Facilities Department Approved Date: ____________
SOP: Lockout/Tagout Effective Date: _____________

Scope:

Effective hazardous energy control procedures will protect team members during machine and equipment servicing and maintenance where the unexpected energization, start up or release of stored energy could occur and cause injury, as well as while working on or near exposed deenergized electrical conductors and parts of electrical equipment. Hazards being guarded against include being caught in, being crushed by, being struck by, being blown from, or contacting live electrical circuits/parts.

The procedure established will ensure that machines and equipment are properly isolated from hazardous or potentially hazardous energy sources during servicing and maintenance and properly protect against reenergization.

While any team member is exposed to contact with parts of fixed electrical equipment or circuits that have been deenergized, the circuits energizing the parts shall be locked out and tagged.

Only when disconnecting means or other devices are incapable of being locked out, and until lockout capability is provided, will a tagout procedure without lockout be utilized.

Definitions:

<u>Authorized Team Member</u>
A person who locks out machines or equipment to perform servicing or maintenance on that machine or equipment. An affected team member becomes an authorized team member when that team member's duties include performing servicing or maintenance that exposes him/her to potentially hazardous energy.

<u>Affected Team Member</u>
A person whose job requires him/her to operate/use a machine or equipment or work in an area in which servicing or maintenance is being performed or under lockout.

<u>Energy Isolating Device</u>
A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following:

- A manually operated electrical circuit breaker
- A disconnect switch
- A manually operated switch by which the conductor of a circuit can be disconnected from all ungrounded supply conductors and no pole can be operated independently

- A line valve
- A block, and similar device used to block or isolate energy

Push buttons, selector switches and other control circuit type devices are not energy isolating devices.

<u>Other Team Member</u>
A person whose work operations are or may be in the area where energy control procedures may be utilized.

Rules:

A. Items used for lockout/tagout procedures shall be provided by Ilani.
B. Lockout devices shall be singularly identified. They will be the only devices used for controlling energy and **<u>will not</u>** be used for other purposes.
C. The lockout devices will indicate the identity of the team member applying the devices.
D. All machines/equipment shall be locked out to protect against accidental or inadvertent operation when such operation could cause injury to team member (s). Lockout will also apply when working on or near exposed deenergized electrical circuits/parts.
E. No team member shall attempt to operate any switch, valve, or other energy isolating device which is locked out.
F. Each lockout device shall only be removed by the team member who applied the device.

Lockout Procedure

A. <u>Preparation for shutdown.</u>
   1. In preparation for lockout, locate and identify all energy isolating devices to be certain which devices apply to the machine/equipment to be locked out. More than one energy source may be involved.
   2. Before an authorized or affected team member turns off a machine or piece of equipment, the team member must have knowledge of the type and magnitude of the energy to be controlled, and the methods and means to control the energy.

B. <u>Machine or equipment shutdown</u>
   1. All affected team members shall be notified that a lockout system is to be utilized and the reason for it, before the controls are applied.
   2. If the machine or equipment is operating, shut it down by normal procedure.

C. <u>Machine or equipment isolation</u>
   1. Physically locate and operate the switch, valve, or other energy isolating devices so the equipment is isolated from energy sources.

D. <u>Applying lockout device.</u>
   1. Authorized team members shall lockout energy isolating devices with assigned individual locks
   2. Lockout devices shall be applied so that they hold the energy isolating devices in a neutral or off position.

E. <u>Stored energy</u>
   1. All stored or residual energy shall be blocked or dissipated. If there is a possibility of reaccumulating of stored energy, verification of isolation must be continued until servicing and maintenance is completed.

F.

1. Prior to starting work on machines or equipment that have been locked and after ensuring no personnel are exposed, the authorized team member shall operate the normal operating controls to verify that the appropriate equipment or machine has been deenergized and make certain it will not operate.
2. Return operating controls to neutral or off after the test

The machine/equipment is now locked out. Servicing or maintenance may now occur.

Removal of Lockout Devices

A. After the servicing/maintenance is completed, follow this sequence of activities:
   1. Check the machine/equipment to be sure it is operationally intact, tools have been removed, and guards have been replaced.
   2. Check to be sure all personnel are safely positioned
   3. Notify all affected team members that locks/tags are going to be removed and the machine is ready for operation.
   4. Remove the locks, blocks, or other energy restraints.
   5. Restore all energy to the machine.

Additional Requirements

A. If more than one person is required to lockout machines/equipment (group lockout), the following procedures shall be implemented to provide protection to all team members.
   1. A primary authorized team member will be designated and responsible for the number of people working under the protection of the group lockout device. The primary person will ascertain the exposure status of each individual member participating in the group lockout to ensure continuity of protection for everyone. Additionally, this primary authorized person will be responsible for the notification of affected personnel before and after lockout procedures are performed.
   2. Each authorized team member will place his/her personal lockout device on the energy isolating device (s).
   3. When an energy isolating device cannot accept multiple locks, a multiple lockout system must be used.

B. <u>Shift or personnel changes</u>

If a lockout procedure will extend into the following shift, the authorized person who originally placed the lock will remove it and it will immediately be replaced with a lock of the authorized team member who is to continue the repair or maintenance on the equipment for the following shift.

C. <u>Cord and plug connected equipment</u>

If Service is performed on cord and plug connected equipment, the following procedure shall be performed:
   1. Unplug the equipment from the electrical socket.
   2. Place a lockable cover over the plug and lock on a plug cover during servicing or maintenance.

D. <u>Training</u>

Authorized team members shall receive training covering:
1. Recognition of hazardous energy sources.
2. Types and magnitude of hazardous energy in the workplace.
3. Methods, devices and procedures used to lockout, verify lockout, and otherwise control hazardous energy on all types of equipment.

4. Procedures for removing locks and returning the machine/equipment to operation.
5. Transfer of lockout responsibilities.
6. Group lockout procedures.

Tagout Procedures

A. When disconnecting means or other isolating device in incapable of being locked out, a tagout system shall be utilized. A tag used without a lock, shall be supplemented by at least one additional safety measure that provides a level of safety equivalent to that obtained by use of a lock such as opening and additional disconnecting device, removal of an isolating circuit element, blocking of a controlling switch or removal of a valve handle to reduce the likelihood of inadvertent energization.
B. Only tags furnished by Ilani shall be used.
C. All team members shall be trained in the limitations of tags.
D. All team members must be able to understand the hazard warnings written on tags.
E. On all machines and equipment where tagout is used instead of lieu of logout, all other lockout rules apply.

References:

Definitions:

SOP – Standard Operating Procedure